

# **NIOSH AGRICULTURAL CENTERS**

**WESTERN CENTER FOR AGRICULTURAL  
HEALTH & SAFETY**

**ANNUAL REPORT**

**FISCAL YEAR 2004\***

**(\*October 1, 2003 - September 30, 2004)**

## CALIFORNIA

### WESTERN CENTER FOR AGRICULTURAL HEALTH AND SAFETY

#### I. INTRODUCTION & EXECUTIVE SUMMARY OF THE PROGRAM

Fiscal Year 03-04 has been another productive year for the Western Center for Agricultural Health & Safety (WCAHS) with noteworthy accomplishments. We are particularly excited about new and continuing work in several important areas relating to regional agricultural health and safety. These efforts were reflected in scientific publications, professional meetings, and public media attention. Specific accomplishments are noted below. General areas of accomplishment include: 1) increased work addressing economic issues pertinent to agricultural health; this work has been mainly done by Dr. Paul Leigh of the Department of Public Health Sciences (formerly Epidemiology and Preventive Medicine) and the collaborative efforts of Dr. Stephen McCurdy for the Social Marketing component of the Tractor Safety Initiative proposal; 2) new initiatives and funded research focusing on Hispanic hired farmworkers and health issues related to poverty, occupational and environmental exposures, immigration and acculturation by Dr. Marc Schenker and his team of researchers; 3) on-going Train-the-Trainer program for pesticide safety by Dr. O'Connor-Marer and his capable team of outreach educators and outreach through the Small Farm Program headed by Desmond Jolly; 4) important ergonomic improvements in mechanical harvesting and hand weeding directed by Drs. John Miles and Fadi Fathallah with the Dept. of Agricultural and Biological Engineering; 5) improvements and standardization of cholinesterase testing methods for use in medical monitoring and surveillance, headed by Dr. Barry Wilson; and 6) a brand new effort to look at emissions of mega-dairy facilities and their health effects lead by Drs. Kent Pinkerton and Frank Mitloehner. Efforts of the Center continue to address health and safety issues for the wide diversity of farmers and farmworkers in Western agriculture, including farm owners and managers, migrant and seasonal farmworkers, and farm family members including children. WCAHS hosted the first of planned semi-annual site visits by NIOSH and other center directors on May 13-14, 2004 at UC Davis. Investigators from both our Center and the Pacific Northwest Agricultural Center (PNASH) presented their ongoing research. Furthermore, a center directors' meeting with NIOSH leadership was also facilitated during that time. Our collaborative efforts for the third joint Agricultural Health and Safety Conference, hosted by PNASH in Troutdale, OR, September 12-14, 2004, was a successful event, that attracted a large, diverse group of attendees. The program brought forth new ideas and directions for both Centers, with a focus on populations and practices that keep Western agriculture sustainable. Regional agricultural health and safety activities of the Center continue at an increased pace with distribution of information using many formats: the Center's web site, list serve and newsletter, audio cassettes, videos, radio spots, CD's, and news releases.

## A. CENTER ACCOMPLISHMENTS FOR FY 2004

1. During this past year Drs. John Miles and Fadi Fathallah continued their research into ergonomic stressors and prevention of task-based injuries. Dr. Miles introduced a new technique that greatly increases the productivity of the strawberry workers, but also promotes and increases the amount of the work cycle spent in a deep stooped posture. Dr. Fathallah has been researching the problem of identifying the most hazardous conditions when tractors are used.
2. Intensive use of anticholinergic pesticides and threats of chemical warfare agents establish the need for rapid, reliable and transferable determinations of blood cholinesterase levels to provide early warning of exposures to such neuroactive chemicals. This year Dr. Barry Wilson's lab worked with California clinical laboratories to evaluate accuracy of individual labs. His work has identified that the majority of laboratories in the state do not have acceptable accuracy for their assays, leading to their deregistration.
3. Dr. Paul Leigh continued his cost analysis of occupational injury and illness in agriculture (and other industries). The costs of agricultural injuries in the U.S. (~\$4.75 billion) are about the same as the costs of hepatitis C, yet very few of us are aware of this fact. He has more recently estimated the magnitude of undercounting of occupational injuries by federal statistics.
4. Dr. Stephen McCurdy has continued his outreach to adolescence of highschool age to encourage safe agricultural practice behaviors. He has also been collaborating with other centers to conceive and write-up parts of the Tractor Safety Initiative proposal.
5. Our third collaborative conference with PNASH "*Cultivating a Sustainable Agricultural Workplace*" provided an opportunity for investigators from both centers to build collaborations between the centers. Agricultural health and safety professionals from regulatory agencies, health care providers, agricultural industries, and community organizations, as well as faculty from colleges and universities, also attended and were able to network and share their work. Presentations and panel discussions highlighted the similarities in agriculture from each region. Over 100 people attended the conference in Troutdale, OR, September 12-14, 2004.
6. Dr. Marc Schenker continued to study and compare health status of women in an immigrant community in Madera, California and women from the companion "sending community" in Michoacan, Mexico. His work also continued to analyze the health effects of agricultural work with a specific focus on respiratory disease and birth outcomes among Hispanic women and health status of California farm owners and operators in the UC Davis farmer cohort.
7. Dr. Kent Pinkerton examined airborne particles as well as characterized exposure conditions, which are paramount to defining health effects associated with ambient particulate matter. His ongoing studies in the laboratory continue to define these conditions for both the Sacramento and San Joaquin regions of the Central Valley using state-of-the-art technology to concentrate ambient particles from Davis, Fresno, and Sacramento in California.

8. During the past year, Dr. Patrick O'Connor-Marer and Center investigators have continued their collaborating with US EPA and Cal DPR to develop and conduct train-the-trainer pesticide safety programs for growers, agricultural workers, health care providers, regulators, and other entities in California and tribal lands in Arizona. Furthermore, curricula have been started to serve the growing Hmong population in California.

## **B. REGIONAL ACTIVITIES**

### **1. States Served by Center:**

Arizona, California, Hawaii, and Nevada

### **2. States with Center Activity for FY 2004:**

California, Arizona, and Hawaii

## **II. REPORT ON THE OUTREACH PROGRAM**

*Outreach to Tribal Communities.* Program staff worked with the Inter Tribal Council of Arizona, Inc. (ITCA) to offer two series of train-the-trainer workshops that focused on improving the health of tribal community members in California and Arizona. Participants included members from tribal communities in Arizona, California, New Mexico, Iowa, Nevada, and Nebraska. Attendees also represented a variety of agencies, facilities, and services working directly with tribes on pesticide, health, and environmental issues. Among the participants were physicians, nurses, outreach workers, industrial hygienists, pesticide educators, and first responders, such as firefighters, paramedics, and police officers. ITCA's Environmental Quality Programs Director and pesticide program inspectors have expressed interest in continuing to work with Center investigators to develop additional pesticide programs and resources for tribal health care providers and Native American community members.

*Outreach to Health Care Providers.* This year, investigators conducted workshops for health care providers, health and safety outreach educators, and agricultural professionals in Oakland and Pacific Grove. These included full-day and half-day sessions.

### III. CENTER PROJECT REPORT BY CORE/TYPE

#### A. PROJECT TITLE

Administration

#### B. PROJECT OFFICER(s)

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#### C. PROJECT DESCRIPTION

The Administrative Core is responsible for coordinating all Center activities and provides the infrastructure for the Center. This includes communication between NIOSH and Center investigators and between the WCAHS and other NIOSH agricultural health and safety centers; and between the Center and related academic departments, government agencies, industry, and worker organizations. The Core is responsible for planning and staffing seminars, conferences, and committee meetings; and for facilitating regional interactions, public events, and special projects. The Core administers the Center's budget, records, and common resources (*e.g.* computer hardware) and maintains and provides materials to outside contacts when requested. The administrative office also oversees the Communications Core, which includes the newsletter, web page, Internet listserve, and media interactions.

#### D. PROJECT START AND END DATES

Started October 1, 1998. Anticipated ending date not determined.

#### E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

The Western Center for Agricultural Health & Safety continues to bring together a unique, multidisciplinary team of experts to address the substantial and complex problems of health and safety in western agriculture. The Center is composed of 11 Principal Investigators from the School of Medicine, the College of Agricultural and Environmental Science, the School of Veterinary Medicine and other programs (*e.g.*, Small Farms program, Integrated Pest Management, *etc.*). In addition, 15 Co-Investigators and 14 assistant researchers collaborate on Center projects.

The Davis campus is positioned strategically in California's Great Central Valley, the most productive agricultural region in the world. Immediate access is possible to a wide range of agricultural sites for research and the development, testing, and implementation of interventions and programs to improve agricultural health. Davis is also located very close to Sacramento and the state headquarters for many relevant agencies including California's Environmental Protection Agency (EPA), Department

of Food and Agriculture, and the Department of Industrial Relations and Health Services. This close proximity facilitates numerous interactions and collaborations between Center investigators and State workers in these agencies.

### **Campus support for the Center**

The University of California at Davis continues to be extremely supportive of the Center. This support has included commitment of space for office, laboratory, and fieldwork, matching funds for equipment purchases, and in-kind salary support for faculty, staff, and administrators involved with the Center.

### **Internal Advisory Committee**

The Center is led by an Internal Advisory Committee under the direct leadership of the Center Director. Committee members represent a spectrum of Colleges and agencies (*e.g.* medicine, agriculture, and environmental science), and scientific approaches used in Center work (*e.g.* epidemiology, toxicology, *etc.*).

### **Center administration**

The Center is under the direction of principal investigator, Dr. Marc Schenker. Deputy Director, Dr. Patrick O'Connor-Marer, and Research Director, Dr. Stephen McCurdy assist Dr. Schenker in administration of the Center. Dr. Ketty Mobed is the Center Manager and is responsible for administrative support to the Director and Center investigators.

### **External Advisory Committee**

The External Advisory Panel is formed by a spectrum of individuals representing diverse agricultural health “stakeholders” in the region and meets mostly on an annual basis. The purpose of this panel is to provide input to the Center on the needs and concerns of the agricultural community, and feedback on the activities of the Center. Another important function is to facilitate information about Center activities and programs to the broader agricultural community. The panel also functions to facilitate communication and interaction among the various stakeholders in the region concerned with agricultural health and safety, to make the most efficient use of the available resources to address this large and important topic.

### **Center seminars and investigator meetings**

Numerous forums exist within the Center for the direct interaction and communication of Center activities by Center Investigators. The specific purpose of these is to facilitate the multidisciplinary interactions critical to addressing the complex issues involved in agricultural health and safety.

The Seminar Speaker program, which is held monthly, with additional seminars as opportunities arise, also serves to facilitate communication and interaction of various disciplinary approaches to agricultural health and safety, these include a strong focus on completed projects and on recruiting speakers who are not affiliated with the Center. The 2003-2004 seminar series continued to bring a spectrum of speakers from inside

and outside the Center to present on agricultural health and safety topics.

We continue to publish our quarterly newsletter, which reaches an audience of more than 2,700 farmers and farm organizations, researchers, health care providers, and policy makers and is also distributed electronically to the more than 250 subscribers of the Center's list server "**aghealthnews**." All previous copies of the newsletter are accessible from the Center home page.

The Center has enhanced its home page (<http://agcenter.ucdavis.edu/>) by increasing the links to other pertinent web sites and by including a list of more than 2,500 Western Center publications that are available to the public. Information on investigators, activities, research, outreach and other information about the Western Center is available at the web site as well.

The Center maintains a list server called **aghealth**, which is a newsgroup forum for announcements, articles and discussion of agricultural health and safety issues. The **aghealth** list of subscribers includes members from the US government, educational institutions in the US and abroad, and private and commercial accounts. **Aghealth** list subscribers are able to post information, messages, and announcements pertaining to ag health and safety.

### **Regional meeting**

A joint conference entitled "Cultivating a Sustainable Agricultural Workplace" was held at in Troutdale, OR, September 12-14, 2004 with the Pacific Northwest Center for Agricultural Safety and Health. This collaborative conference highlighted work being done by both the Centers and brought investigators together to explore where collaborations could take place. Conference participants included representatives from regulatory agencies, health care providers, colleges and universities, community organizations and agricultural industries. Breakout sessions covered field studies, evaluation of education programs, respiratory disease while panels and discussions included injury epidemiology, ergonomics, engineering and technologies to aid the researcher, risk communication, and interventions.

## **F. PROJECT PRODUCTS**

### **2. Publications**

- a. Fact Sheets / Brochures / Technical Publications:** Western Center for Agricultural Health & Safety – Center Brochure
- b. Other Publications:** Newsletter (Fall 03, Winter, Spring, Summer 04)

### **3. Education / Training / Outreach**

- a. News Letters:** Newsletter (Fall 03, Winter, Spring, Summer 04)

### **4. Conferences / Meetings Sponsored:**

- o Monthly Brown-Bag Seminars. UC Davis, CA. October 2003-June 2004.
- o Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course.

- Chico, CA. January 8, 2004.
- o Update on Pesticide Laws and Regulations. Landscape and Nursery Exposition. Sacramento, CA. January 14, 2004.
  - o Hands-on Workshop, Instructor Training. Lodi, CA. January 21, 2004.
  - o Stock Hands-on Workshop, Instructor Training. Napa, CA. March 2, 2004.
  - o Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. San Luis Obispo, CA. March 17, 2004.
  - o Pesticide Handler and Fieldworker Instructor Training. (English). Davis, CA. April 19, 2004.
  - o Fieldworker Instructor Training. (English). San Luis Obispo, CA. April 20, 2004.
  - o Pesticide Handler and Fieldworker Instructor Training (Spanish). Davis, CA. April 26, 2004.
  - o NIOSH-Ag Center Director's Meeting. UC Davis, CA. May 13-14, 2004.
  - o Preventing Pesticide Contamination of Water. Fresno, CA. June 11-2004.
  - o Language Needs of Pesticide Handlers. Pesticide Regulation Enforcement Program, Davis, CA. July 27-30, 2004.
  - o Pesticide Illnesses and Injuries: A Workshop for Health Care Providers and Agricultural Professionals. Oakland, CA. August 18-19, 2004.
  - o Early Determinants of Adult Health: 6<sup>th</sup> Annual UC Davis Conference for Environmental Health Scientists. Napa, CA. August 30, 2004.
  - o Pesticide Illnesses and Injuries: A Workshop for Health Care Providers and Agricultural Professionals. Asilomar, CA. August 31-September 1, 2004.
  - o Cultivating a Sustainable Agricultural Workplace. Troutdale, OR. September 12-14, 2004.

**G. STATES THE PROJECT WAS ACTIVE IN**  
California, Arizona, Hawaii, Nevada



**III. CENTER PROJECT REPORT BY CORE / TYPE:**

**A. PROJECT TITLE**

Incident Disease & Injury Among a Cohort of California Farmers & Farm Operators

**B. PROJECT OFFICER(S)**

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**C. PROJECT DESCRIPTION**

This project involves an ongoing series of health studies among a cohort of California farmers aimed at identifying the prevalence and risk factors for acute and chronic disease, and ultimately at the prevention of disease in this population. The major focus is on hazards predominantly occurring between California and other western farmers, or on western risk factors for common diseases (e.g. dry climate farming as a risk factor for respiratory disease). The follow-up component allows us to measure incidence of diseases and health conditions, determine the characteristics of farmers most likely to have developed new disease, and determine the change in work practices that takes place as this cohort continues to age. Progress was made on several components of the farmer cohort study during this time period.

**D. PROJECT START AND END DATES**

Started October 1, 1997. Anticipated ending date not determined.

**E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

**UC Davis Farmer Health Study Timeline to date: Major Components**

<b>DATE</b>	<b>1993</b>	<b>1995/6</b>		<b>1998</b>		<b>2002/3</b>	<b>2004</b>
<b>Component</b>							
Random sampling of all farms (CASS defined) in CA - 1947 completed CATI	√						

Case-based sampling of farmers from Central Valley 50% with respiratory symptoms. 777 completed CATI, 374 of these completed in-field PFT, 2-week diary of symptoms and peak flows, and blood test for allergic status (RAST.)		√					
Follow-up questionnaire on all reachable and consenting original participants. Complete CATI for 1349				√			
Follow-up intensive respiratory study of subset of 199/56 subsample. Questionnaire, PFT and HRCT of 62 subjects in 1:1 ratio of those classed in 1996 with lower lung function from PFT's, and normals matched on sex and age.						√	
Second follow-up of entire cohort. CATI completed for 866 subjects							√

Project activities were focused mostly on two components:

**i) A follow-up survey of disease, symptom and conditions to provide prevalences and where possible incidences among as many as possible of the original 1993 sampling of Californian farm operators.**

**Methods:**

A Computer Assisted Telephone Interview was developed and pilot tested in the fall of 2003, and administered early 2004. This follow-up questionnaire continued assessing the core activities of the project and monitored current health. The new version of the questionnaire updated the demographics of the cohort with regards to work status, commodities produced, current tasks personally performed and current symptoms and health status. The focus was on long term exposures to different farming tasks and environmental risk factors ( including non-farm jobs, smoking history, and the home environment) in association with current respiratory and musculoskeletal health and functional abilities. Mental health and the development of chronic diseases were also assessed in detail as with an aging cohort these problems are expected to become more prevalent. Interviews of up to 45 minutes began in early February 2004, and were completed by the end of April 2004.

**Survey methodology and dispositions:**

The cohort members available for contact included 1262 subjects who completed the CATI in 1998 and 304 of the subjects who completed an interview in 1993 but did not complete the 1998 survey. 866 questionnaires were completed in 2004. This reflected a resurvey rate of 804 out of 1262 (64%) for those surveyed in both 1993 and 1998, and 62 out of the 304 (20.4%) who were unobtainable in 1998. These numbers reflect known deaths (total now runs over 125), and compare with the previous resurvey rate of 69% in 1998. Given the mobility of populations, changes in telephone usage and the advanced age of the group, we expected a significant number

of untraceable farmers in 2004. To counteract these trends, a letter of re-introduction was sent to all existing addresses, and the farmer was given the option to exclude themselves from the study. The interview company made extensive use of 411 look-ups, internet search engines and used established accounts with ancestry.com, US SEARCH™ and NEXUS. Scripted messages were left for potential respondents on the 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup> and 15<sup>th</sup> call attempts (varying time of day and day of week including weekend), leaving a toll-free number to call. After the 12<sup>th</sup> call, a letter was sent to the most recent address for the potential respondent requesting they called a toll free number either to the interview company or the study office at UC Davis. An appropriate waiting period was left before more attempts made, and a second letter sent after the 15<sup>th</sup> call. Cohort members were classed as unreachable if a current phone number was not discovered, or 20 telephone contact attempts had been made. Considerable effort was made to evaluate and use only valid proxies for impaired subjects. In all, 35 (4%) of the 866 completed questionnaires in 2004 were conducted by proxies. In addition, 65 respondents (7.5%) were randomly chosen for a short quality control check (validation study), and 139 of the respondents who refused to complete a full interview answered a short refusal questionnaire to give basic demographic and health information.

### **Results:**

Preliminary analyses were conducted on the cohort to assess demographic changes (Tables 1 and 2), current Health conditions (Table 3), and changes in the prevalence of respiratory symptoms 1993-2004 (Table 4).

The mean age of the current cohort was 64.3 (SD = 12.1) years, up from 58.6 (12.7) in 1998 and 54.4 (13.4) in 1993. The median acreage increased over the 11 year period from 60 in 1993 to 98.5 in 2004, but the averaged hours per week worked remained stable at around 33 hours (mean) or 30 hours (median). From table 2, the percentage of women farmers has remained constant, only increasing slightly in 2004 to 11.1%, however the percentage of primary operators has dropped (due to retirement, etc – see Figure 1) to 73.2%, and current smokers now only make up 6.4% of the cohort, where as in 1993 they were 12%. Since 1998 (the question was not asked in 1993), the primary commodity distribution among the farms has remained stable with fruit, livestock or nut growing being the most common. The regional distribution of the farms around California was maintained, with a possible exception in Southern California, which appeared to lose a greater percentage of participants.

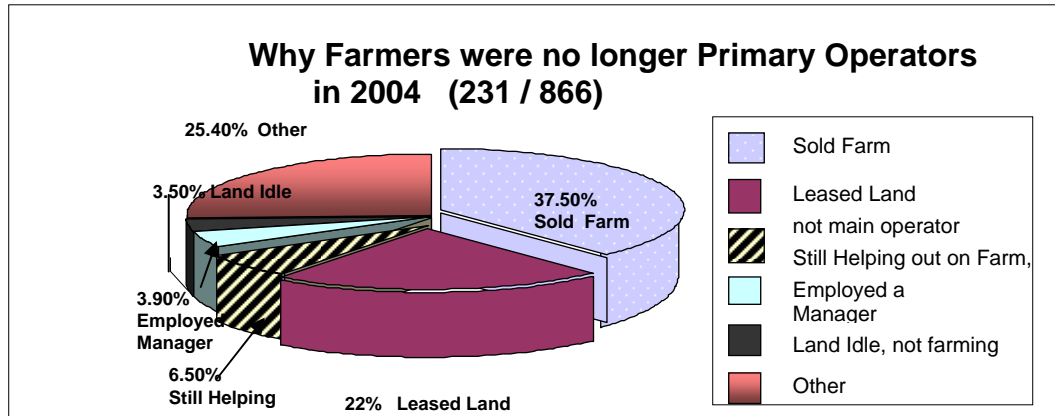
**TABLE 1 : DEMOGRAPHIC CHANGES 1993-2004**

Survey Date	1993				1998				2004			
	N	Mean (SD)	Median	Range	N	Mean (SD)	Median	Range	N	Mean (SD)	Median	Range
Age (Years)	1947	54.4 (13.4)	54	21-90	1347	58.6 (12.7)	58	29-95	866	64.3 (12.1)	64	36-94
Acres	n>0 = 1939	1062 (6473)	60	1-164,000	n>0 = 1142	1227 (15415)	75	1 – 500,000	n>0 = 602	808 (3223)	98.5	1 – 60,000
Hours worked/week	n>0 = 1871	33.7 (23.5)	30	0.25 – 108	n>0 = 1164	34.8 (22.6)	33.8	0.5 – 112	n>0 = 620	33.4 (21.9)	30	0.25 – 98

**TABLE 2: DEMOGRAPHIC CHANGES Continued**

Survey Date	1993		1998		2004	
	n	(%)	n	(%)	n	(%)
Returning Participants	1947	100	1349/1947	69.3	866/1349	64.2
Sex (% Female)	196	10.1	138	10.2	96	11.1
Primary Operator	1946	100	1122	83.2	633	73.2
Current Smoker	233	12.0	146	10.9	53	6.4
Primary Commodity last 12 months;	Not Available		1998 (%)		2004 (%)	
Fruit			21.1		20.4	
Nuts			15.9		18.5	
Field Crops			11.1		10.0	
Row Crops			4.5		5.7	
Grapes			14.7		13.4	
Nursery products			3.8		2.9	
Livestock			22.4		21.5	
Other			6.6		7.6	
Regional Distribution of Farms;	1993 (%)		Not Available		2004 (%)	
North Coast	9.8				10.3	
Central Coast	7.8				8.6	
Sacramento Valley	15.9				17.3	
San Joaquin Valley	44.7				46.5	
Mountains	6.0				5.4	
Southern California	15.9				11.9	

Figure 1



With regards to health status, joint, nerve, emotional problems, injury and respiratory conditions were not apparently age associated in 2004 (Table 3). Joint problems have the highest prevalence of all the disease conditions; it may well be that these problems develop at an early age in farmers – and remain a chronic problem.

There had been an increase in the prevalence of all respiratory symptoms monitored between 1993 and 2004, with chronic bronchitis increasing 5.2% over 1993 levels, and persistent wheeze

TABLE 3: HEALTH CONDITIONS	PERCENT OF EACH AGE GROUP REPORTING HEALTH CONDITION				
	CONDITON	AGE GROUP IN 2004			
PREVALENCE OF:	COMBINE D (ALL AGES)	< 65	65 – 75	> 75	Trend: $\chi^2$ value
Diabetes	12.2	8.0	16.4	21.7	<0.0001
Stroke / CVA	3.6	4.5	4.6	8.1	0.005
Myocardial Infarction	8.5	4.2	12.8	15.1	<0.0001
Skin Cancer	19.7	15.2	26.4	24.1	0.001
Other Cancer	12.0	4.0	21.5	22.3	<0.0001
HEALTH LIMITATIONS: Condition limits Work					
Heart Disease	6.4	2.5	6.4	17.1	<0.0001
Lung Disease	7.0	5.0	8.4	10.7	0.029
Joint Problems	25.7	23.2	28.7	29.4	NS
Nerve Problems	13.5	13.8	17.8	8.3	NS
Neurological Problems	2.5	1.1	2.1	6.6	0.0002
Accident / Injury	12.0	11.3	13.5	11.8	NS
Emotional Problems	2.1	2.7	1.0	1.6	NS
Other Limitation	13.3	9.9	14.1	21.3	0.0005
Respiratory Conditions:					

<b>Asthma</b>	<b>11.3</b>	<b>11.5</b>	<b>12.4</b>	<b>9.5</b>	<b>NS</b>
<b>Persistent Wheeze</b>	<b>11.1</b>	<b>11.1</b>	<b>12.7</b>	<b>9.5</b>	<b>NS</b>
<b>Chronic Cough</b>	<b>8.7</b>	<b>7.7</b>	<b>10.7</b>	<b>9.0</b>	<b>NS</b>
<b>Chronic Bronchitis</b>	<b>9.1</b>	<b>8.4</b>	<b>9.6</b>	<b>10.5</b>	<b>NS</b>

<b>TABLE 4: CHANGES IN THE PREVALENCE OF RESPIRATORY SYMPTOMS (% of Cohort)</b>			
<b>SURVEY YEAR</b>	<b>1993</b>	<b>2004</b>	<b>CHANGE</b>
<b>Chronic Bronchitis</b>	<b>3.9</b>	<b>9.1</b>	<b>+ 5.2</b>
<b>Chronic Cough</b>	<b>4.2</b>	<b>8.7</b>	<b>+ 4.5</b>
<b>Persistent Wheeze</b>	<b>8.6</b>	<b>11.1</b>	<b>+ 2.5</b>
<b>Asthma (Physician Diagnosed)</b>	<b>7.8</b>	<b>11.3</b>	<b>+ 3.5</b>

increasing the least 2.5% over the same time period. (Table 4)

Preliminary analyses focusing on longitudinal risk factors for respiratory symptoms will be pursued over the next year. We also intend to extend the analyses to examine other longitudinal predictors of chronic disease/conditions in this cohort.

#### **ii) Intensive investigation of farmers with occupational dust exposure and respiratory symptoms**

The second major component was a continuation of the intensive respiratory study reported last year, investigating the respiratory status of farmers exposed to a range of agricultural dusts. All of the participants lived in the California Central Valley – an area of intensive agriculture and high levels of inorganic dust including silica and silicates, capable of inducing airway and interstitial changes in the lung. This project combined the use of High Resolution computed Tomography [HRCT] and Pulmonary Function Tests [PFT] to comprehensively assess lung function and interstitial changes in relation to agricultural environmental exposures. The study hypotheses were:

- ❖ Long-term exposure to higher levels of dusts from agricultural operations result in associated increases in both obstructive (airflow disorders) and restrictive (including interstitial) lung disease.
- ❖ While both organic and inorganic dusts contribute to breathing problems, an association exists between chronic inorganic dust exposure and interstitial pulmonary disease.

#### **Methods:**

31 male farmers identified with below normal pulmonary function [Forced Expiratory Volume in 1 second (FEV1) or Forced Vital Capacity (FVC) below 80% predicted, or with the FEV1/FVC ratio below 0.7] were designated ‘cases’ were selected from the cohort of farm operators who participated in PFT in the field in 1995/6. They were age and sex matched with 31 farmers with normal PFT values [controls], and reassessed in the winter of 2002/3. Environmental exposures and health status were recorded by interviewer administered questionnaire. Pulmonary function was assessed by PFT including diffusion and lung volume by helium dilution. HRCT chest scans were scored for opacities by consensus recording while blinded to subject status. Simple

associations between dust exposures, respiratory symptoms, pulmonary function and HRCT scaring of the airways and interstitium were examined and logistic regression models used for multivariate association analysis.

**Results:**

Mean age of farmers was 66.9 years (sd=11.2), 79% (n=49) were still working on the farm, and spent an average of 23 hrs/wk on farming tasks. (See Table 5). Of the total study group, 32% had an FEV1 below 80% predicted, 24% had FVC below 80% predicted, and 40% FEV1/FVC below 0.7.

[TABLES ON NEXT PAGE ARE EMBEDDED!]

**TABLE 5: DEMOGRAPHICS**

CHARACTERISTIC	CONTROLS		CASES	
	n	Mean (sd)	n	Mean (sd)
Age	31	67.1 (11.2)	31	66.8 (11.4)
Years Farmed	31	47.6 (13.6)	31	42.7 (15.4)
* Acreage	25	218.6 (359)	20	75.7 (74.3)
* Hour/wk all farm work	27	36.3 (20.7)	22	21.7 (20.5)
Hour/wk non-farm work	8	21.3 (12.4)	10	32.4 (16.2)
Cumulative dust score (0-10)	31	5.2 (2.0)	31	5.0 (2.0)
† Dust Index	31	246 (120)	31	209 (112)

CHARACTERISTIC	CONTROLS		CASES	
	n	Percent	n	Percent
Still Primary Operator	23	74.2%	19	61.3%
Smoking Status	31		31	
Never	13	41.9%	12	38.7%
Ex-smoker	16	51.6%	14	45.2%
Current	2	6.5%	5	16.1%
† † Pack-years (ever smokers)	18	18.5 (mean)	19	44 (mean)

\* Difference between controls and cases significant  $p < 0.05$

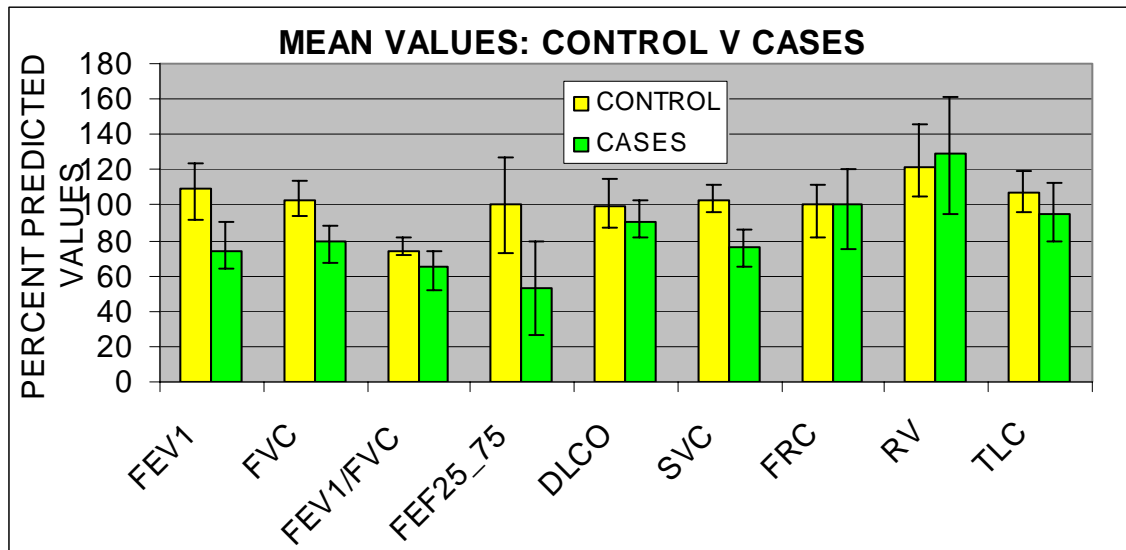
† Dust Index = (Cumulative dust score) (years farmed)

† † Pack-years = (Years smoked)(Number cigarettes/day) / 20

In 2002/3 those designated as cases in 1995/6 performed significantly less well than the controls in all measures of spirometry and diffusion, ( $p < 0.025$ ), but there was less difference in lung volumes. (Figure 2)



**Figure 2 : PULMONARY FUNCTION TESTS : MEANS AND INTERQUARTILE RANGES.**



† Inter-quartile ranges: top of each bar indicates 75th percentile, and bottom, the 25th.  
 †† [mean Forced Expiratory Flow between 25-75 th percent of the Forced Vital Capacity maneuver (FEF25-75)], Carbon monoxide diffusing capacity (DLCO), Slow vital capacity (SVC), Functional Residual Capacity (FRC), Residual Volume (RV), Total Lung Capacity (TLC). The RV and TLC are extrapolated from the SVC and the FRC. All measures except FRC and RV were significantly different comparing controls to cases either pre or post bronchodilator  $p < 0.025$ .

HRCT scores for airway disease ranged from 0 (no abnormalities) (56.5%) to 23 [max. possible 54], and 27/62 (43.5%) demonstrated abnormalities of airway tissue as defined by HRCT scans. 63% of those with airway abnormalities were ‘cases’ and this difference was significant with ( $p < 0.05$ ). Scores for interstitial abnormalities ranged from 0 (85.5%) to 7 [max. possible 72], and 9/62 (14.5%) had abnormalities of interstitial tissue as defined by HRCT scans of the chest, but there was no significant difference in interstitial scarring between cases and controls. Univariate associations were found between HRCT identified airway disease and PFT measures of airflow obstruction, and also with age or whether the farmer had ever smoked. Among cases there was an association between cumulative dust exposure and CT airway score ( $p < 0.05$ ), FEV<sub>1</sub> and FEV<sub>1</sub>/FVC ( $p < 0.05$ ). Multivariate models adjusted for age and smoking, disclosed independent associations between HRCT airway abnormalities and FEV<sub>1</sub> ( $p = 0.006$ ) or FEV<sub>1</sub>/FVC ( $p = 0.005$ ), but although dust exposure was positively associated with HRCT interstitial abnormalities, no adjusted association was found between dust exposure and pulmonary function or HRCT scarring. In logistic regression analysis, the presence of airway abnormalities as defined by HRCT were associated with PFT measures of obstruction (FEV<sub>1</sub>, DLCO, FEV<sub>1</sub>%, FEF25-75) and increased FRC, adjusted for age and smoking status (Table 6).

**TABLE 6: ASSOCIATION BETWEEN HRCT ABNORMALITIES AND PULMONARY FUNCTION IN ALL SUBJECTS**

AIRWAY SCORE (ANY : NONE)	UNADJUSTED MODELS		† ADJUSTED MODELS	
	OR	95% CI	OR	95% CI
Independent Variables:				
Age	1.07	1.03 – 1.12	NA	NA
Pack-years smoked	3.17	1.09 – 9.2	NA	NA
Measures of Obstruction:				
FEV1 % Predicted	0.959	0.934 – 0.985	0.931	0.88 – 0.99
Dlco % Predicted	0.948	0.915 – 0.981	0.929	0.87 – 0.993
FEV1 /FVC	0.918	0.867 – 0.971	0.86	0.75 – 0.98
FEF 25_75 % Predicted	0.984	0.973 – 0.996	0.975	0.953-0.997
Volume Measures :				
FRC % Predicted	1.029	1.007 – 1.051	1.026	1.003 – 1.049
INTERSTITIAL SCORE (ANY: NONE)				
Age	1.094	1.001-1.196	NS	NS
High dust (score x years) categorized low: high	6.11	1.37 – 27.33	NS	NS

† Adjusted for age and smoking status or pack-years where appropriate  
 No association seen with Vital Capacity or Total Lung Capacity

**Conclusions and Continuing Analyses:**

Given the sample size the number of subjects who demonstrated interstitial abnormalities (n=9) on HRCT scans was too small to adequately test the hypothesis that long term exposure to mixed agricultural dusts, including high levels of inorganic minerals, lead to interstitial disease. There appears to be good correspondence between HRCT measures of airway abnormalities and PFT measures of obstructive disease, and at least a weak association between the measures of self-reported dust exposure and both airway disease and interstitial scarring. The questionnaire collected data on tasks previously associated with dust generation (earlier component of this study) and both home and other environmental exposures to particulates and other air pollutants. We plan to investigate associations between these activities and lung function /pathology, and explore the longitudinal relationships between the various measures of pulmonary health and occupational / environmental exposures between the 1995/6 and 2002/3 surveys.

**Other Activity:**

Overall, analyses of the data gathered in 1993, 1998, and 2002-4 will continue to address the major study questions and hypotheses, with publication of results on various aspects of the study.

1] Analyses continued on the first baseline study (1993), and work was completed on manuscripts from the baseline data. Over the current year papers have been published addressing nonfatal occupational injury, the identification of agricultural tasks which provide the dominant exposures to inhalable and respirable dust in California, and analysis of self-reported dermatitis

and skin cancer in the Farmer Health Study cohort.

2] In 1998, 1,349 farm operators completed a telephone interview assessing relevant health outcomes, occupational hazards, and functional status. Analyses are continuing of this 1998 cohort sample. These analyses include an assessment of incident respiratory disease, and comparison of risk factors of incident disease with those seen for prevalent disease in 1993. Two manuscripts examining work ability and functional limitations in this cohort are currently in preparation, and another looking at musculo-skeletal problems and occupational tasks conducted by the farm operators

## **F. PROJECT PRODUCTS**

### **2) Publications:**

#### **a. Peer Reviewed Journal**

Schenker MB. Overview: Agriculture and Human Health. In: David J. Rapport, et al. (Eds). *Managing for Healthy Ecosystems*. CRC Press LLC. 2003; pp.783-785.

Susitaival P, Kirk JH, Schenker MB. Atopic symptoms among California veterinarians. *AJIM* 2003; 44:166-71.

Schenker MB. Biostatistics and Epidemiology. In: LaDou J, (ed.). *Current Occupational and Environmental Medicine*, 3rd edition. Lange Medical Books/McGraw-Hill, 2004, pp 818-840, ISBN: 0-8385-7219-7.

Wu, J, Nieuwenhuijsen MJ, Samuels SJ, Lee K, Schenker MB. Identification of agricultural tasks important to cumulative exposures to inhalable and respirable dust in California. *AIHA Journal* 2003; 64:830-836.

McCurdy SA, Farrar JA, Beaumont JJ, Samuels SJ, Green RS, Scott LC, Schenker MB. Nonfatal occupational injury among California farm operators. *Journal of Agricultural Safety and Health*, 2004; 10(2):103-119.

O'Connor-Marer P, Schenker MB. Pesticide Poisoning. In *Preventing Occupational Disease and Injury*, 2nd ed. Part II Occupational Diseases and Injuries. American Public Health Association, 2003 (in press).

Lee K, Lawson RJ, Olenchock SA, Vallyathan V, Southard RJ, Thorne PS, Saiki C, Schenker MB. Personal Exposures to Inorganic and Organic Dust in Manual Harvest of California Citrus and Table Grapes. *Journal of Occupational and Environmental Hygiene*, 2004; 1: 505-514.

Susitaival P, Beckman R, Samuels SJ, Schenker MB. Self-reported dermatitis and skin cancer in California farm operators. *AJIM*, 46:136-141, 2004.

**d. Other Publications: Abstracts**

Schenker MB, Lee K, Stoecklin MT, Lupercio R, Zeballos J. Pulmonary function and exercise testing among paraquat exposed workers. *Eur Respiratory J* 22, Supplement 45, P1942, 2003.

Schenker M, Elvine-Kjreis B, Beckett L, Bethel J, Kasirye O, Walsh J. Health profiles of immigrant Hispanic women working in agricultural and non-agricultural jobs. Fifth International Symposium: Future of Rural Peoples, Saskatoon, Canada, October 19-23, 2003.

Schenker MB, Lupercio R, Enright P, Stoecklin M, Zeballos RJ. Sensitive measures for field studies of occupational interstitial and restrictive lung disease. Fifth International Symposium: Future of Rural Peoples, Saskatoon, Canada, October 19-23, 2003.

Lee K, Stoecklin M, Hennessy T, Park E-K, Beckett LA, Schenker MB. Use of Personal Protective Equipment and Exposure to Herbicide among Handlers in Costa Rica. American Industrial Hygiene Association Conference, May 8-13, 2004, Atlanta, Georgia, USA.

Vallyathan V, Elvine-Kreis B, Pinkerton KE, Green F, Schenker MB. Inorganic dust load and small airways fibrosis in the lungs of autopsied California farm workers. ATS International Conference, Orlando, May 21-26, 2004. *Am J Resp Crit Care Med* 2004; 169(7):A47.

Schenker MB, Lee K, Mitchell D, Shelton D, Parker J. Long-term exposure to agricultural dusts in the California: association with pulmonary function and high resolution CT. ATS 100th International Conference, Orlando 2004. *Am J Resp Crit Care Med* 2004; 169(7):A47.

Mitchell D, Lee K, McCurdy S, Schenker MB. University of California at Davis Farmer Health Study: Third survey of the Cohort. Third annual Western Agriculture Health and Safety Conference, Troutdale, Oregon September 12-14, 2004.

**G. STATES THE PROJECT WAS ACTIVE IN  
California**

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

The Study of Agricultural Lung Disease (SALUD)

#### **B. PROJECT OFFICER(s)**

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#### **C. PROJECT DESCRIPTION**

SALUD is a cross-sectional study of pulmonary function and paraquat exposure among agricultural workers in Costa Rica. The study included two components: (1) an exposure assessment component, and (2) an epidemiological study with interviewer administered questionnaires and pulmonary function testing, including single breath diffusion capacity and oxygen desaturation testing. The specific project aims are to:

- Administer a questionnaire on work history, demographics and health outcomes to 340 current farm workers.
- Measure pulmonary function including diffusion capacity among farm workers in the sample.
- Measure oxygen desaturation using exercise oximetry in the sample of farm workers.
- Measure current paraquat exposure by biological markers in a subset of current farm workers.
- Characterize current and cumulative paraquat exposure among farm workers, based on work histories and exposure assessment results.
- Evaluate possible independent association of cumulative long-term paraquat exposure with respiratory symptoms and pulmonary function in study subjects.

#### **D. PROJECT START AND END DATES**

January 1, 2001 – June 2004

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Over the last year, the study objectives have been the analysis of data; preparation and dissemination of study results to farm owners, managers, and workers in Costa Rica;

and preparation of peer-reviewed manuscripts.

## **F. PROJECT PRODUCTS**

### **1. Presentations:**

- Pulmonary function and exercise testing among paraquat exposed workers: The Study of Agricultural Lung Disease (SALUD), European Respiratory Society – Vienna, Austria, September 27-October 1, 2003.
- Sensitive measures for field studies of occupational, interstitial and restrictive lung disease, 5<sup>th</sup> International Symposium Future of Rural Peoples, Saskatoon, Saskatchewan, Canada, October 19 – 23, 2003.
- Use of personal protective equipment and exposure to herbicide among handlers in Costa Rica, 2004 American Industrial Hygiene Conference and Expo, Atlanta, Georgia, May 8-13, 2004.

### **2. Publications**

#### **a) Peer Reviewed Journal:**

- Schenker MB, Stoecklin M, Lee K, Lupercio R, Zeballos RJ, Enright P, Hennessy, Beckett LA, Pulmonary Function and Exercise-associated Changes with Chronic Low-Level Paraquat Exposure, *Am J Respir Crit Care Med.* 2004 Oct 1;170(7):773-779.
- Koivunen M, Gee SJ, Park, EK, Schenker MB, Hammock BD, Application of an enzyme-linked immunosorbent assay (ELISA) for the analysis of paraquat in human exposure samples. Submitted to *Archives of Environmental Contamination and Toxicology.*
- Lee K, Park EK., Stoecklin M., Koivunen M, Gee SJ, Beckett LA, Hammock BD and Schenker MB, Occupational Exposures of Agricultural Workers to Paraquat in Costa Rica. Submitted to *Annals of Occupational Hygiene.*
- Lee K, Stoecklin M, Hennessy T, Park EK, Beckett LA and Schenker MB, Use of Personal Protective Equipment among Herbicide Handlers in Costa Rica. Submitted to *International Archives of Occupational and Environmental Health.*
- Yang W, Lee K, Chung M, Characterization of indoor air quality using multiple measurements of nitrogen dioxide. *Indoor Air* 2004, 14:105-111.

#### **c) Fact Sheets / Brochures / Technical Publications:**

Worker fact sheet, The Study of Agricultural Lung Disease (SALUD) developed and disseminated study results to farm owners, managers and workers in Costa Rica.

## **G. STATES THE PROJECT WAS ACTIVE IN**

California, Costa Rica

## **VI. COLLABORATION**

NIEHS Center for Environmental Health Sciences at UC Davis

### III. CENTER PROJECT REPORT BY CORE / TYPE:

Field Studies Facilities Core/ Epidemiology & Respiratory Toxicology

#### A. PROJECT TITLE

Pulmonary Fibrosis and Mineral Content of Lung Tissues from Deceased California Farm Workers

#### B. PROJECT OFFICER(S)

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#### C. PROJECT DESCRIPTION

California agricultural workers have increased respiratory symptoms, decreased respiratory function and increased mortality rates from chronic obstructive pulmonary disease. Previous case reports have observed pneumoconiosis with inflammation and fibrosis associated with silica or silicate exposure among agricultural worker populations in California, but there have been no previous epidemiologic studies of lung pathology in farmworkers. From consecutive coroner's cases of males in Fresno County, lung samples were collected for systematic evaluation of early histologic lesions and dust exposure. Work and smoking histories were obtained by the coroner's office.

The overall objective of this study was to examine the relationship between mineral dust exposure in the farming industry and histopathological changes occurring in the lungs of the California farmworker. Histologic and dust load findings in farmworkers will be compared to non-farmworkers. The study is also designed to show the importance of airway branching patterns in the deposition, retention, and histopathology associated with mineral dusts in the lung.

The specific aims of this project were to:

Document and quantify pathologic lesions in lung tissues from Hispanic males autopsied by the Coroner's Office in Fresno, California;

Determine the quantity, identity, size, distribution and associated compounds of mineral particles in selected lung tissue samples;

Determine the distribution of inhaled mineral dust within precisely defined airway paths;

Compare histologic changes in lung tissue samples which had high and low dust loadings;

Compare predicted particle retention with observed particle retention along specific airway paths, making use of the information on particle number and dimension determined in specific aim 2.

#### **D. PROJECT START AND END DATES**

5/94 – 7/98

Analysis and manuscript preparation on-going.

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

In May of this year, Dr. Val Vallyathan presented findings on the extent of inorganic dust deposition and its characteristics in the lungs of autopsied California Farmworkers at the American Thoracic Society's International Conference. Overall, results from this work indicated that the accumulation of mineral dusts in farm workers contribute to airway disease. His findings further demonstrated the value of autopsy studies in documenting whether or not the contemporary ambient dust standard is adequate to prevent health hazards in residents and farm workers.

The bulk of activities this year have been focused on re-sampling and scoring additional lung tissue samples obtained from the study population. The decision to re-sample and score additional slides was made based on the findings published in 2000 by Dr. Kent Pinkerton, where the distribution of particles and histologic features of the membranous and respiratory bronchioles were analyzed. Respiratory bronchioles, in longitudinal profile, were identified as either first, second, or third generation. This analysis showed that histological changes in lung tissue were particularly abundant and heavy in the adventitial wall of membranous bronchioles and within the walls of the first-generation respiratory bronchioles (severity of lung pathology decreased over the second and third generations). As a result of these findings, it was decided that further analysis efforts would best be targeted at the membranous bronchioles and the first generation respiratory bronchioles. In order to ensure adequate power for the analysis, it was determined that each case would require a minimum of three complete sets of respiratory bronchioles consisting of contiguous first generation bronchioles. As a result, Dr. Francis H.Y. Green, M.D., Professor, Department of Pathology, University of Calgary, has spent the last year grading additional slides for each case on the extent of fibrosis, muscle hypertrophy, inflammation, visible and polarizable pigment, and intraluminal macrophages. Each feature is graded from 0 to 3, where 0 represents no evidence of that feature, and 1-3 represents increasing grades of severity. Once these additional data are added to the current dataset, analyses will be conducted to compare the prevalence of pulmonary pathology in this sample of decedents in non-agricultural and agricultural occupations.



## **F. PROJECT PRODUCTS**

### **1. Presentations:**

Vallyathan V., Elvine-Kreis, B., Pinkerton KE, Green F., Schenker MB. (May, 2004). Inorganic Dust Load and Small Airways Fibrosis in the Lungs of Autopsied California Farm Workers. Presented at the annual conference of the American Thoracic Society, Orlando, FL.

## **G. STATES THE PROJECT WAS ACTIVE IN**

California; West Virginia; Alberta, Canada

## **VI. COLLABORATION**

### **University of California, Davis**

Dr. Kent Pinkerton

Professor (In-Residence), Department of Anatomy, Physiology, and Cell Biology, School of Veterinary Medicine, and Director, CHE, John Muir Institute of the Environment

### **University of Calgary**

Dr. Francis Green

Faculty of MEDICINE (Medical School)

Pathology and Laboratory Med

### **NIOSH**

Dr. Val Vallyathan

Team Leader, Pathology & Physiology Branch, NIOSH

### III. CENTER PROJECT REPORT BY CORE/TYPE:

#### A. PROJECT TITLE

Farm Work and the Epidemiological Paradox of Low Birthweight Delivery Among Hispanic Women in California

#### B. PROJECT OFFICER(s)

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530-754-7159

#### C. PROJECT DESCRIPTION

Immigrants represent nearly 11% of the US population, the highest proportion in the last 50 years. Although this foreign-born population is a diverse group, it is generally socioeconomically disadvantaged relative to the native-born population, with higher poverty rates and higher proportion of uninsured individuals. Latinos are the largest ethnic minority group in the US with a foreign-born population of 40%. Although socioeconomic disadvantage is associated with less favorable perinatal outcomes, foreign-born Latinas generally have lower rates of low birthweight (LBW) infants than US-born Latinas, an epidemiological paradox. Even more disturbing is the observation that Latina immigrant women experience worsening birth outcome the longer they live in the US, despite increasing access to prenatal care, improved socioeconomic status and better education. As migrant women become acculturated to the US, they must be exposed to factors that adversely affect pregnancy outcomes. The investigator hypothesizes that job stress and occupational exposures related to farm work best explain the worsening of pregnancy outcomes among Latina women. However, studies on birth outcomes related to farm labor have been inconclusive due to potentially biased study populations and low statistical power. California provides the ideal location for this study; 44% of all Latinos are foreign-born and 58% (2 million) of the Latina women over age 16 were employed in 1996, more than half as farm or other manual laborer.

The overall goal of the proposed research is to identify Latina women who are at risk for adverse pregnancy outcome among US-born and foreign-born Latina women residing in California between 1980-2001, with specific aims to:

**Aim 1:** Perform descriptive analyses to examine the temporal pattern of rates of low birthweight (LBW) deliveries and maternal demographic and occupational risk factors for LBW deliveries for foreign-born and US-born Latina women over a 20-year period (1980-2000) using California birth certificate data;

**Aim 2:** Test the epidemiological paradox of low birthweight (LBW) deliveries to Latina

women in California using birth certificate data from 2000-2002. The hypothesis is that foreign-born Latina women have lower rates of LBW infants than US-born Latina women;

**Aim 3:** Analyze the association between maternal occupation, maternal birthplace, and low birthweight deliveries in California using birth certificate data from 2000-2002. The hypothesis is that occupational exposures related to farm work best explain the difference in rates of LBW delivery to foreign-born and US-born Latina women.

#### **D. PROJECT START AND END DATES**

March 2003 to present.

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Progress continues on the doctoral thesis project in Epidemiology undertaken by Jeffrey Bethel. One of the three parts of the dissertation was completed during the past year. The first chapter used data from the Study of Hispanic Acculturation, Reproduction, and the Environment (SHARE, PI Dr. Marc Schenker). The purpose of this chapter was to examine the association of preterm, low birthweight (PTLBW) deliveries in a cohort of Hispanic women of varying lengths of U.S. residency who: 1) worked in agriculture, 2) worked in non-agriculture industries, and 3) did not work. Rates of PTLBW delivery did not differ by occupation group. However, the three occupation groups had significant differences in rates of smoking, drinking and drug use during pregnancy in addition to other key demographics.

The final two chapters of the dissertation will utilize California Birth Certificate data sets (2001-2002 to: 1) validate the current Hispanic paradox and 2) examine the association of maternal employment in agriculture and PTLBW deliveries. The data sets include basic demographics for the mother and father, birth outcome and pregnancy/labor data as well as maternal and paternal occupations. To date, the data sets have been imported into an appropriate statistical package, the data have been cleaned, labeled, coded, and initial analyses have been conducted. Again, the mothers' occupation will be coded as agricultural work, non-agricultural work, and no work. These two chapters of the dissertation are expected to be finished by June 2005.

#### **F. PROJECT PRODUCTS**

- a. 1. Presentations: UC Davis Ag Center Grad Student Seminar, October 3, 2003.

#### **G. STATES THE PROJECT WAS ACTIVE IN California**

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

Determinants of Health and Disease Among Mexican Migrants to California

#### **B. PROJECT OFFICER(s)**

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#### **C. PROJECT DESCRIPTION**

Our goal is to conduct a pilot study to characterize the changes in risk factors and associated disease among Hispanic migrants to California, and to understand the underlying causes for these changes. The focus will be on major risk behaviors (smoking, diet, exercise, drug use, sexual behavior) and health outcomes affecting this population. Primary considerations for this study include respiratory, reproductive, nutritional, and mental health outcomes. The effects of occupational exposures, including agricultural work will also be considered. Participants will be recruited from a community in Mexico (Chavinda) and a corresponding community in California (Madera).

Specific aims/objectives:

- Administer a health survey to 100 women aged 18 – 45 who were born in Mexico and are currently living in Madera, California
- Administer a health survey to 100 women aged 18 – 45 who were born in Chavinda, Michoacán and are still residing there
- Examine behavior and illness profiles in both communities in an effort to separate the effects of “selective migration” from the social-cultural changes associated with migration and living in a different environment
- Investigate the multifaceted relationship between immigration, acculturation, occupation and adverse health risk factors
- Examine differences in risk factor profiles between Mexican residents and immigrants at varying levels of acculturation

#### **D. PROJECT START AND END DATES**

07/01/2003 to 12/29/2004

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Data collection for 100 women has been completed in Chavinda, Michoacán and the data is undergoing cleaning and primary analysis.

Data has been collected from 93 women in Madera, California.

#### **F. PRODUCTS**

##### **1. Presentations:**

*Agricultural Work, Migration and Acculturation in Female Mexican Migrants: Preliminary Data from the CMHI Binational Study (poster)* presented September 2004 at the Pacific Northwest Agricultural Safety and Health Conference in Troutdale, Oregon

#### **G. STATES THE PROJECT WAS ACTIVE IN**

California

Michoacán, Mexico

#### **VI. COLLABORATION**

Instituto Nacional de Salud Publica, Cuernavaca, Mexico  
California Institute for Rural Studies, Davis, CA

### III. CENTER PROJECT REPORT BY CORE/TYPE:

#### A. PROJECT TITLE

Developing, Improving, and Applying Cost-Effective & Accurate Human Blood, and Cholinesterase Determinations

#### B. PROJECT OFFICERS

Barry W. Wilson, PhD, Principal Investigator  
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Patrick J. O'Connor-Marer, PhD, Co-Investigator  
Michael J. O'Malley, MD, Co-Investigator

#### C. PROJECT DESCRIPTION

This project combines field, clinical, mission-oriented research and outreach to improve cholinesterase (ChE) testing required of pesticide applicators the State of California to provide a standard for ChE testing of those exposed to anticholinergic agriculture and chemical warfare chemicals. In collaboration with Cal EPA Department of Pesticide Regulation (DPR) and the Office of Environmental Health and Hazard Assessment (OEHHA) we have been optimizing conditions for sampling, storage, and assay of blood for acetylcholinesterase (AChE) and butyrylcholinesterase (BChE). The improved tests are being validated in field studies, standard operating procedures are being prepared and disseminated, and local laboratories are being helped to standardize and harmonize their assays with our laboratory standard. Outreach activities include informing clinical laboratories, state and federal agencies, growers, spray applicators, and field workers of the importance of the measurements and the need to measure them accurately. In addition, we are working with the US Department of Defense blood ChE monitoring unit, the US Army Center for Health Promotion and Preventive Medicine (CHPPM), and their large database to establish normal levels for ChEs and develop a conversion factor for two widely used cholinesterase measurements. Also, we are reaching out to consult on a new cholinesterase monitoring program in the state of Washington.

#### **Specific Aims:**

- (1) Identify conditions necessary to successfully standardize and optimize ChE measurements of clinical laboratories and a portable ChE kit making them interconvertible with each other, and capable of reproducibly detecting exposures to OPs and carbamates (CBs).
- (2) Provide a readily useable standard for ChE assays.
- (3) Establish a normal range for blood ChEs using the large sample base available from CHPPM of the DOD.

- (4) Improve current ChE reactivation techniques for detecting inhibited ChEs, providing a rapid method to qualitatively establish OP pesticide exposures have occurred.
- (5) Improve current ChE assay techniques by testing fluorescent substrates.
- (6) Test the effectiveness of improved techniques by monitoring farmworkers, and their families, when appropriate.
- (7) Work with Center outreach staff to disseminate the findings to clinics, public health agencies, growers and farmworker organizations to help them improve the safety and surveillance conditions in the agricultural workplace.

#### **D. PROJECT START AND END DATES**

Start: October 1, 1997. Continuing project; end date not yet determined.

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

##### **Specific Aim 1**

A careful comparison of the Ellman assay performed under optimum conditions and the DOD pH assay was performed to examine the variability and reliability of both assays, to establish baseline values and to generate conversion factors to enable comparisons between them and other proposed or commercial assays.

Previous tests comparing the CHPPM delta pH assay and the UCD Ellman assay were carried out on split RBC samples collected by CHPPM and shipped to UCD. The results were inconsistent. To reduce variability, volunteer blood was collected at UCD and both assays were run at UCD. The RBCs were prepared following the procedures used by CHPPM, which did not include washing the RBCs after the plasma fraction was removed. The presence of plasma in the sample was checked by comparing washed and unwashed RBCs, and by using specific ChE inhibitors. Washing had no effect on the ChE activity. The specific AChE inhibitor, BW284c51, inhibited the ChE activity in the RBC preparation ( $p < 0.01$ , ANOVA). The specific BuChE inhibitor, quinidine, slightly inhibited RBC activity ( $p < 0.01$ , ANOVA), while inhibiting almost all ChE activity in plasma ( $p < 0.01$ , ANOVA).

Substrate concentration curves were generated to check whether the assays were being performed under optimal conditions. The Ellman assay displayed decreased RBC AChE activity when the substrate concentration was 5 mM or greater. There was also a decrease in RBC AChE activity in the delta pH assay, but not until the substrate concentration exceeded 10 mM. There was no decrease in plasma BuChE activity with substrate concentrations up to 20 mM in the delta pH assay.

The RBC preparations were treated with varying concentrations of a ChE inhibitor to mimic OP-exposed samples and broaden the range of observed activities. Diisopropyl fluorophosphate (DFP) was chosen because it does not require metabolic activation to be an effective ChE inhibitor. Whole blood was treated with DFP prior to centrifugation. The RBCs were washed to remove residual DFP before being measured by each assay system. This was repeated using blood from 3 volunteers. Linear regression yielded an estimated conversion factor between the two assays of:  $\text{delta pH} = (0.091 \times \text{Ellman}) +$

0.0052.

### **Specific Aim 2**

We tested the stability and usability of a red blood cell ghost standard suitable for clinical standardizations. The task has been accomplished and the results published (Arrieta *et al.*, 2003). The activity of the preparation on hand was too low to use for the delta pH method. We plan to increase the activity level in a new preparation. The ghost RBC standard is included in each Ellman microplate assay conducted at UCD. Others including the laboratories at the state of Washington and Walter Reed Hospital have requested the standard.

### **Specific Aim 3**

A normal range of delta pH ChEs from the DOD monitoring program was determined previously. The distribution of these activities was converted into Ellman units using values from 991 unexposed individuals ranging from 18 to 76 years of age. There was no influence of age or gender. The average activity was  $8.11 \pm 0.67$  umol/min/ml (mean  $\pm$  SD). The range of activity was 6.3 to 10.7 umol/min/ml (95% confidence interval).

### **Specific Aim 4**

A project with Dr Keating at Lawrence Livermore Laboratory has drawn to a close without establishing an improved technique. We hope to return to this problem at a later time.

### **Specific Aim 5**

We have been working with a group from McGill University in Canada examining the performance of a fluorescent commercial kit that is so sensitive the assay must be run at suboptimal acetylcholine concentrations. They obtain what appears to be useable results and we intend to investigate the assay further.

### **Specific Aim 6**

There are several possible populations that may be available to us to test the conversion factors and human blood cholinesterase ranges. One is the population of DOD personnel sampled by CHPPM. Unfortunately they keep only the RBC portion of the blood and permission will be needed to study the plasma. The second population is the mixer, loader applicators being studied in Washington. We are in the process of inquiring how these blood samples may be used in our studies. A third population is that of a town in California where Center Director Dr. Schenker is starting an in depth study of farmworker health. We hope to be working with some of these subjects now that we have accomplished assay conversions and established normal human ranges for the blood enzyme.

### **Specific Aim 7**

Our results have been presented in talks to groups in California and surrounding states arranged by Center Outreach staff Pat Marer and Jenny Weber and at a number of professional meetings listed below. In addition, Wilson serves on several CA EPA



Pesticide Advisory Committees and on the advisory committee for the Washington cholinesterase monitoring project.

## **F. PROJECT PRODUCTS**

### **1) Presentations**

Arrieta DE, VM Nihart, JD Henderson, RE Reitstetter, LJ Lefkowitz and BW Wilson. Comparing Cholinesterase Assays used to Detect Pesticide Exposure and Chemical Terrorism. Presented at the Annual National Institute for Occupational Safety and Health Meeting: "Cultivating a Sustainable Agricultural Workplace"; September 11-14, 2004; Troutdale, Oregon.

Arrieta DE, VM Nihart, JD Henderson, SA McCurdy, RE Reitstetter, LJ Lefkowitz and BW Wilson. Comparison of Delta pH and Ellman Colorimetric Cholinesterase Assays. Presented at the Bioscience 2004 Medical Defense Review; May 16-21, 2004; Hunt Valley, Maryland.

McCurdy SA, JD Henderson, DE Arrieta, LJ Lefkowitz, RE Reitstetter, and BW Wilson. Determining a Reference Value for Blood Cholinesterase using US Defense Department Personnel. Presented at the 43<sup>rd</sup> Annual Meeting of the Society of Toxicology; March 21-24, 2004; Baltimore, Maryland.

S.A. McCurdy, J.D. Henderson, D.E. Arrieta, L.J. Lefkowitz, R.E. Reitstetter, and B.W. Wilson. 2003. Normal range of cholinesterase levels among US Defense Department personnel. Presented at NIOSH Conference, November, 2003 San Francisco, CA.

Wilson BW, JD Henderson, DE Arrieta, SA McCurdy and RE Reitstetter. Conversion of Delta pH and Ellman Values for Cholinesterase. Presented at the 42<sup>nd</sup> Annual Meeting of the Society of Toxicology; March 9-13, 2003; Salt Lake City, Utah.

### **2) Publications**

#### **Peer Reviewed Journal:**

- Wilson BW and Gunderson P. 2004. "Biological and Chemical Terrorism and the Agricultural Health and Safety Community" J. Agromedicine, (In Press)
- Whitehead A, Anderson SL, Ramirez AB and Wilson BW. Fish cholinesterases in aquatic biomonitoring: assay optimization and species-specific characterization. (In Press)
- Joyce BA, Wallender WW, Angermann TE, Wilson BW, Werner I, Oliver MN, Zalom FG, Henderson JD. 2004 Using Infiltration Enhancement and Soil Water Management to
- Reduce Diazinon in Runoff", Journal of the American
- Water Resources Association. (In Press)
- Eder KJ, Leutenegger CM, Wilson BW, Werner I. 2004. Molecular and cellular biomarker responses to pesticide exposure in juvenile Chinook salmon (*Oncorhynchus tshawytscha*). Marine Environmental Research 58(2-5):809-813
- Wilson BW, Henderson JD, Arrieta DE, O'Malley MA. 2004. Meeting

requirements of the California cholinesterase monitoring program. International Journal of Toxicology 23(2): 97-100

- Arrieta D, Ramirez A, DePeters E, Bosworth, D, Wilson BW. 2003. Bovine red blood cell ghost cholinesterase as a monitoring standard. Bulletin Environ. Contam. Toxicol. 71(3):447-452

**Other Publications:**

- Wilson BW. 2004. "Cholinesterases" in Handbook of Pesticide Toxicology, 2<sup>nd</sup> edition, Academic Press (In Press)
- Wilson BW. 2004. "Cholinesterases" in Encyclopedia of Toxicology, 2<sup>nd</sup> Edition, Oxford. (In Press)

**3) Education / Training / Outreach**

**Training Seminars:**

- Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. Chico, CA, January 8, 2004; San Luis Obispo, CA. March 17, 2004.
- Update on Pesticide Laws and Regulations. Landscape and Nursery Exposition. Sacramento, CA. January 14, 2004.
- Hands-on Workshop, Instructor Training. Lodi, CA. January 21, 2004; Napa, CA. March 2, 2004.
- Pesticide Handler and Fieldworker Instructor Training (English). Davis, CA. April 19, 2004; (Spanish) Davis, CA. April 26, 2004.
- Fieldworker Instructor Training (English), San Luis Obispo, CA. April 20, 2004.
- Language Needs of Pesticide Handlers. Pesticide Regulation Enforcement Program. Davis, CA. July 27-30, 2004.
- Pesticide Illness and Injuries Workshop. Oakland, CA. August 19, 2004.

**G. STATES THE PROJECT WAS ACTIVE IN**  
California; Washington

**V. REPORT ON SPECIFIC IMPROVEMENTS IN AGRICULTURE SAFETY AND HEALTH THAT RESULTED FROM CENTER ACTIVITIES (RESEARCH TO PRACTICE)**

- 1) Certification of clinical laboratories in California with cholinesterase assays harmonized with our NIOSH supported protocol.
- 2) Establishment of a normal range of human cholinesterase values.

**VI. COLLABORATION**

Rupali Das, MD, Occupational Health Branch (OHB), CA Dep't of Health Services (CDHS)

Matthew Keifer, MD, University of Washington

Lee Lefkowitz, PhD, Captain US Army, CHPPM

Raven Reitstetter, PhD, Captain US Army, Collaborator

Hing Man Chan, PhD, McGill University, Quebec Canada

Garrett Keating, PhD, Lawrence Livermore Laboratory

Stephen McCurdy, MD, MPH, Collaborator

John D. Henderson, Research Associate

Daniel Arrieta, PhD Student

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

Health effects of ambient airborne particles from the Sacramento/San Joaquin Valley

#### **B. PROJECT OFFICER(s)**

Kent Pinkerton, PhD, Principal Investigator  
Department of Anatomy, Physiology and Cell Biology  
University of California  
One Shields Avenue  
Davis, CA 95616  
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[kepinkerton@ucdavis.edu](mailto:kepinkerton@ucdavis.edu)

#### **C. PROJECT DESCRIPTION**

The overall objective of this study is two-fold: (1) to examine the relationship between mineral dust exposure in the farming industry and histopathological changes occurring in the lungs of the California farmworker and (2) to determine the respiratory health effects of short-term exposure to concentrated ambient particles in California. This two-fold research approach is designed to examine the health effects of inhaling ambient particles derived from the environment (both agricultural and urban) on the respiratory tract. Studies conducted in both humans and laboratory animals will help us to better understand the importance of airway branching patterns in the deposition and retention of particles in the lungs, as well as histopathological changes that may be associated with the inhalation of mineral dusts. These studies should further elucidate whether short-term exposure to Central Valley particles leads to an adverse respiratory response. The unique working environment of the California farmer places him/her at increased risk for particle exposure. Due to dry farming techniques used in the Central Valley of California, these farmworkers are exposed to high levels of dust through a variety of operations including field preparation (plowing), rice stubble burning, and crop harvesting of tomatoes, grapes, and citrus fruits. The specific aims of this phase of the project are: (1) to document and quantify pathologic lesions arising along unique anatomical pathways in lung tissues from Hispanic males autopsied by the Fresno, California, Coroner's office; (2) to compare lung pathology among deceased agricultural workers to that among deceased non-agricultural workers; (3) to determine the quantity and identity of mineral particles in lung tissue samples obtained through airway microdissection techniques and histological findings; and (4) to compare the quantity and identity of mineral particles in lung tissue samples which showed fibrosis upon histological examination and a comparison group of samples which showed no evidence of fibrosis upon histological examination.

The presence of airborne particles arises from combustion as well as anthropogenic sources in the environment. The potential interactions of complex mixtures of particles of varying size and composition need to be better elucidated to define biologically plausible mechanisms for lung injury and disease. Examination of these airborne particles as well as well-characterized exposure conditions are paramount to defining health effects associated with ambient particulate matter. Ongoing studies in our laboratory continue to define these conditions for both the

Sacramento and San Joaquin regions of the Central Valley using state-of-the-art technology to concentrate ambient particles from Davis and Fresno, CA.

#### **D. PROJECT START AND END DATES**

October 1, 2001 – September 30, 2006

#### **E. PROJECT ACTIVITIES/ACCOMPLISHMENTS**

Mineral dust exposure, intrapulmonary dust distribution, and remodeling of the airways along anatomically distinct airway paths have been examined in the lungs of farmers from the Central California Valley. During the past year we have completed sampling of 108 cases for histopathological evaluation. To date we have found a positive correlation between wall thickness and the amount of carbonaceous and mineral dusts present within the transitional region formed by respiratory bronchioles, the interface between the conducting airways and gas exchange region of the lungs. Wall thickening has also been associated with increases in collagen and interstitial inflammatory cells, including dust-laden macrophages. These changes are significantly ( $p < 0.001$ ) greater in first generation respiratory bronchioles (RB) compared to second and third generation RBs. The latest studies will contrast differences in the accumulation of dust in the lungs of farm workers to other occupations.

During the past year we have continued research to examine the effects of short-term exposure of rodents to concentrated ambient particles of the San Joaquin/Sacramento Valley. A number of studies have suggested particle size is an important determinant in adverse health effects.

Particles less than 2.5  $\mu\text{m}$  in diameter are considered to be the most deleterious, while particles with a mean aerodynamic diameter between 2.5 and 10  $\mu\text{m}$ , referred to as coarse particles, are thought to produce less injury to the cardiopulmonary systems. Since the dominant PM fraction in the San Joaquin/Sacramento Valley is coarse particles, especially in the summer and fall seasons, we have extended our studies to examine the effects of exposure to ambient particles in the coarse mode on the lungs of healthy adult rats. Rats were exposed in Fresno, CA and Davis, CA to filtered air or the coarse fraction of PM enhanced approximately 40-fold over ambient levels with a particle concentrator system. Exposure to these particles was for 4 hours per day for 3 consecutive days. The mean mass of concentrated particles ranged from 0.2 to 1.1  $\text{mg}/\text{m}^3$ . PM was composed primarily of nitrate, metals, sulfate, and organic carbon. Bronchoalveolar lavage (BAL) was performed on each group of rats following exposure. Total cells in BAL from rats exposed to concentrated PM were significantly increased during 1 of 2 weeks in Fresno and 2 of 2 weeks in Davis, compared to rats exposed to filtered air ( $P < 0.05$ ). BAL macrophages were increased during 1 of 2 weeks in Fresno and 2 of 2 weeks in Davis, neutrophils increased during all 4 weeks and lymphocytes during 2 of 2 weeks in Davis. The increase in macrophages, neutrophils, and lymphocytes in rats exposed to coarse PM indicates a significant inflammatory response with short-term exposure. These observations suggest that additional studies to elucidate potential mechanisms for possible health effects of coarse particles are warranted. Our most recent series of studies have further examined fine and ultrafine particles in Davis and Sacramento. A total of 4 studies were conducted this past year with 2 studies in Davis and 2 in Sacramento. We have found markedly different particle composition by chemical analysis in each region. Studies are ongoing to determine potential health effects associated with these

exposures.

## **F. PROJECT PRODUCTS**

### **1. Presentations:**

- American Thoracic Society International Conference, “Lung Morphogenesis and Cellular Differentiation: Influence of Exposure Timing on Effects of Environmental Pollutants”, Seattle, WA, May 21, 2003.
- California Air Resources Board: Chairman’s Air Pollution Seminar Series, “Effects on the Respiratory System of Sensitive Animals and Asthmatic Humans”, Sacramento, CA. June 17, 2004.
- John Muir Institute for the Environment, “Toxic Dusts: Big Harm from Tiny Particles in the Environment”, Davis, CA Feb 19, 2004.
- Soil Science Society Annual Meeting, “Respiratory Health Effects of Aerosolic Dusts in California: Rodents, Horses and Humans”, Denver, CO, November 4, 2003.

### **2. Publications**

#### **a. Peer Reviewed Journal**

Last, J.A., Ward, R., Temple, L., Pinkerton, K.E., Kenyon, N.J. Ovalbumin-Induced Airway Inflammation and Fibrosis in Mice Also Exposed to Ultrafine Particles. *Inhalation Toxicology* 16:93-102, 2004

Pinkerton, K.E., Zhou, Y.M., Teague, S.V., Peake, J.L., Walther, R.C., Kennedy, I.M., Leppert, V.J., and Aust, A.E. Reduced lung cell proliferation following short-term exposure to ultrafine soot and iron particles in neonatal rats: key impaired lung growth? *Inhalation Toxicology* 16 (Suppl 1):73-81, 2004

### **3. Education/Training/Outreach**

#### **Training Seminars:**

Dr. Pinkerton has been involved in a number of training seminars during the past year. He has taught undergraduate students at the University of California, Davis on inhalation toxicology. These students have been in the Environmental Toxicology or Engineering programs at UCD.

#### **Hazard Surveys / Consultations:**

Dr. Pinkerton has provided consultation to veterinarians and State officials on environmental asbestos. El Dorado County, located to the east of Sacramento and in the foothills of the Sierra Mountains, has experienced some concerns with tremolite, a type of asbestos, a natural contaminant of the local rock formations in the area. Dr. Pinkerton has provided information regarding the health hazards of asbestos and the potential for human and animal exposure.

## **G. STATES THE PROJECT WAS ACTIVE IN California**

## **IV. COLLABORATION**

Francis Green, University of Calgary

Jane Gallagher, U.S. Environmental Protection Agency

Costantinos Sioutas, University of Southern California

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

Costs of Occupational Injuries in Agriculture

#### **D. PROJECT OFFICER(s)**

J. Paul Leigh, PhD, Principal Investigator  
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One Shields Ave.  
University of California  
Davis, CA 95616  
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[pleigh@ucdavis.edu](mailto:pleigh@ucdavis.edu)

#### **E. PROJECT DESCRIPTION**

Considerable effort went into preparing background reports for publication. One report made extensive use of the BLS's statistics on non-fatal occupational injuries. A second report used data on workers' compensation records in 24 states. The last report used cost data from insurance records on workers' compensation.

#### **F. PROJECT START AND END DATES**

Oct. 1, 2001 – Sept. 30, 2005

#### **G. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

There are three critical findings:

1. The BLS undercounts non-fatal occupational injuries by as much as 50%.
2. Roughly 90% of occupational disease costs are not covered by workers' compensation.
3. Differences in costs across states are largely explained by differences in the composition of industries across states.

#### **H. PROJECT PRODUCTS**

##### **1. Presentations:**

BLS undercount of nonfatal occupational injuries. Presented at meeting of all NIOSH Agricultural Centers Meeting in Davis, CA, May, 2004.

##### **2. Publications**

###### **c. Peer Reviewed Journal:**

1. Leigh JP, Marciniak JP, Miller TR. An estimate of the US government's undercount of nonfatal occupational injuries. *J Occup Environ Med* 46(1):10-18. 2004
2. Leigh JP, Robbins JA. Workers Compensation and Occupational Disease: Coverage, Costs, and Consequences. *Milbank Quarterly*. In press.
3. Waehrer G, Leigh JP, Cassady D, Miller TR. Costs of occupational injuries

across states. J Occup Environ Med. In press.

**G. STATES THE PROJECT WAS ACTIVE IN  
California**

**VI. COLLABORATION**

Geetha Waehrer, PhD  
Pacific Institute for Research and Evaluation, Maryland

Ted R. Miller, PhD  
Pacific Institute for Research and Evaluation, Maryland

J.P. Marcin, MD  
UC Davis School of Medicine

J.A. Robbins, MD  
UC Davis School of Medicine

Diana Cassady, PhD  
UC Davis School of Medicine



### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

**A. PROJECT TITLE:**

Impact of School Agriculture Safety Curriculum on Injury Risk

**B. PROJECT OFFICER(s):**

Stephen McCurdy, MD, MPH, Principal Investigator

Department of Public Health Sciences

One Shields Avenue

University of California

Davis, CA 95616

(530) 752-8051

[mccurdy@epm.ucdavis.edu](mailto:mccurdy@epm.ucdavis.edu)

**C. PROJECT DESCRIPTION:**

There are approximately 100 fatal and 32,000 nonfatal injuries (15,000 of which were work-related) annually among children on U.S. farms. Education figures prominently among efforts to reduce this toll. However, few data exist to document its efficacy. This work represents a pilot longitudinal observational study to evaluate impact of agricultural safety curriculum in California's Central Valley high schools.

- o Specific aim #1. Identify a pilot cohort of 2000 high school students in California Central Valley public high schools who are participating in the state-approved agriculture education curriculum.
- o Specific aim #2. Administer a questionnaire at the beginning of the school year (Fall 2001) to characterize study subjects with respect to demographics, health habits, farm-work exposures, safety-related attitudes and practices, and injury experience in the preceding year. Repeat the survey at the beginning of subsequent school years for four cycles of data collection.
- o Specific aim #3. Evaluate the hypothesis that among students in the agriculture education program, those participating in the safety portion of the curriculum (i.e., enrolled in the Agricultural Mechanics course work) will manifest a 50% reduction in farm-injury risk compared to peers not participating in the safety portion of the curriculum (i.e., not enrolled in Agricultural Mechanics course work) after accounting for relevant confounders, including work exposures.

**D. PROJECT START AND END DATES**

Started October 1, 2000. Anticipated ending date September 30, 2005.

**E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

We have collected data for 1787 students from 10 high schools. We are now entering our fourth year of data collection and plan to expand the study to include 2000 students.

**G. STATES THE PROJECT WAS ACTIVE IN**

### III. CENTER PROJECT REPORT BY CORE / TYPE:

#### A. PROJECT TITLE

Extending Pesticide Related Health & Safety Programs to Underserved Ag Populations

#### B. PROJECT OFFICER(s)

Patrick O'Connor-Marer (retired as of 10/01/04)  
Department of Public Health Sciences  
One Shields Ave.  
Davis, CA 95616  
(530) 752-5585

#### C. PROJECT DESCRIPTION

This study investigated, developed, tested, and evaluated effective ways to bridge language, cultural, and educational barriers that impede the delivery of safety training and hazard awareness information to agricultural workers and their employers. We focused on pesticide safety and pesticide hazard awareness because pesticides are of major concern to agricultural workers and we have considerable expertise in pesticide safety education. The methods we developed and tested serve as models for all other areas of agricultural safety.

Specific Aim 1. Develop and test effective training materials and methods.

Specific Aim 2. Devise methods to assist agricultural employers of underserved populations with methods to provide effective pesticide safety training and hazard awareness programs.

A. Specific Aim 3. Extend information and training to health care and other social service providers.

#### D. PROJECT START AND END DATES

October 1, 1997 – September 30, 2004

#### E. PROJECT ACTIVITIES / ACCOMPLISHMENTS

Specific Aim I Progress:

*Pesticide Safety Curriculum Developed for High School Work-Study Program Students.* Investigators developed and tested a pesticide safety short course for 20 work-study program students participating in the "Construction and Landscape Academy" at a high school in Merced, California. The first lesson contained several activities that focused on ways that students can protect the environment when working with pesticides and other chemicals. Students also participated in hands-on activities that led to better understanding and comprehension of pesticide label instructions especially as they pertain to protective equipment, restricted-entry intervals, and responding to pesticide exposure emergencies. Finally, students became familiar with a variety of resources that are available to assist them in identifying and controlling pests in and around the home, landscape, and farm. The activities included in the lesson plan were designed to fit the occupational and educational needs of

students who are or soon will be employed in agriculture production or landscape maintenance of parks, forests, or golf courses.

*Pesticide Safety for Small Farms Video, Ilocano language version.* After identifying the need for more pesticide safety resources in Ilocano, investigators worked with University of Hawaii at Manoa staff to locate funding, translation, narration, and editing services to develop an Ilocano version of the video, *Pesticide Safety for Small Farms*. This video, which was originally created as a resource for Hmong, Cambodian, and Laotian small farm operators in California, is currently being used to extend pesticide safety information to Ilocano-speaking Filipino farmers in Hawaii

#### Specific Aim 2 Progress:

*Refresher Courses on Training Techniques and Pesticide Safety Resources.* Staff of the Santa Clara County Agricultural Commissioner's office requested a 4-hour short refresher course for people who were already qualified to be pesticide safety trainers. Tim Stock and Jennifer Weber designed and presented information on a variety of training techniques and pesticide safety resources that can be used to develop interesting and effective safety programs for pesticide handlers and agricultural fieldworkers. Hands-on activities were included in the course to allow participants to practice using the methods and tools presented during the course.

*Train-the-Trainer Workshops.* Through over 290 day-long workshops, program staff reached over 4800 people responsible for providing safety training to pesticide handlers and agricultural workers. The trainers who participated in innovative train-the-trainer workshops are responsible for training nearly 900,000 agricultural workers and about 70,000 pesticide handlers. Four of these workshops were conducted in April, 2004. Since 1990, staff also assisted several county organizations in setting up and conducting day-long hands-on training workshops covering all aspects of pesticide handling safety. Staff provided training to the volunteer instructors and loaned materials and props for the workshops. Each workshop accommodates nearly 400 pesticide handlers and training is conducted in English and Spanish. Since the inception of this program, 17 of these workshops have been held and over 5,950 individuals have received training. Well over 300 community members have participated as volunteer trainers. Stanislaus and Napa counties continue to conduct these workshops each year. The latest workshops were held in March, 2004.

#### Specific Aim 3 Progress:

*Outreach to Tribal Communities.* Program staff worked with the Inter Tribal Council of Arizona, Inc. (ITCA) to offer two series of train-the-trainer workshops that focused on improving the health of tribal community members in California and Arizona. Participants included members from tribal communities in Arizona, California, New Mexico, Iowa, Nevada, and Nebraska. Attendees also represented a variety of agencies, facilities, and services working directly with tribes on pesticide, health, and environmental issues. Among the participants were physicians, nurses, outreach workers, industrial hygienists, pesticide educators, and first responders, such as firefighters, paramedics, and police officers. ITCA's Environmental Quality Programs Director and pesticide program inspectors have expressed interest in continuing to

work with Center investigators to develop additional pesticide programs and resources for tribal health care providers and Native American community members.

*Outreach to Rural Health Clinics.* In November 2002, Program staff worked with Family HealthCare Network (FHCN), a private, nonprofit community-based organization that has eight clinical sites in Tulare County, California. FHCN has developed a comprehensive primary health care delivery system serving over 135,000 outpatients and 7,000 inpatients per year. Center investigators and FHCN together developed and presented a workshop on pesticide exposure that served as a staff development course for FHCN clinicians and support staff. FHCN closed each of their eight clinics and administrative offices to enable their 338 health care providers and support staff to attend this important event. FHCN's clientele is multicultural, with 65% of the patients identifying themselves as Hispanic and 10% identifying themselves as Southeast Asian. This year, investigators conducted workshops for health care providers, health and safety outreach educators, and agricultural professionals in Oakland and Pacific Grove. These included full-day and half-day sessions.

## **F. PROJECT PRODUCTS**

### **1. Presentations:**

- Weber, J. Pesticide Safety Train-the-trainer Workshops in Mexico. Western Center for Agricultural Health and Safety Seminar Series. Davis, CA. January 10, 2003.
- Weber, J. Pesticide Safety Tips. Radio Bilingüe Presentation and Live Interview. Fresno, CA. January 22, 2003.
- O'Connor-Marer, P., J. Weber, and T. Stock. Hands-on Workshop, Instructor Training. Lakeport, CA. February 5, 2003.
- O'Connor-Marer, P., J. Weber, and T. Stock. Hands-on Workshop, Instructor Training. Lodi, CA. February 6, 2003.
- Weber, J. Pesticide Safety Train-the-trainer Workshops in Mexico. Northern California Entomological Society, Vacaville, CA. February 7, 2003.
- Weber, J., and T. Stock. Fieldworker Instructor Training (Spanish). Escondido, CA. February 13, 2003.
- O'Connor-Marer, P., J. Weber, and T. Stock.. Handler and Fieldworker Instructor Training (English). Escondido, CA. February 14, 2003.
- Weber, J. Personal Protective Equipment and Preventing Pesticide Exposure. Pesticides and Health Issues Conference for Native American Communities. Lakeport, CA. February 20, 2003.
- Weber, J. Hands-on Demonstrations of Ways to Prevent Pesticide Exposure to People and the Environment. Pesticides and Health Issues Conference for Native American Communities. Lakeport, CA. February 21, 2003.
- Weber, J. Training Techniques and Pesticide Safety Resources. Santa Clara County Growers' Meeting. San Martin, CA. February 26, 2003.
- O'Connor-Marer, PJ. Protecting Yourself from Pesticides and Complying with Pesticide Regulations. Davis, CA. January 28, 2003 and Parlier, CA, February 27, 2003.
- O'Connor-Marer, PJ, *Master Gardener Training for Handling Pesticides Safely*. Sacramento, CA, March 21, 2002, Woodland, CA, March 28, 2002, Asilomar, CA. October 15, 2002, Woodland, CA, March 6, 2003.

- Weber, J. Pesticide Safety: Environmental Protection Issues. Landscape Academy Course. Valley Community High School, Work-Study Program. Merced, CA. March 28, 2003.
- Weber, J. Developing Effective Pesticide Safety Programs for Fieldworkers (Spanish) National Train-the-trainer Program: Master Trainer Orientation. Washington, DC. April 3-4, 2003.
- Weber, J. Pesticide Safety: Label Comprehension and Responding to Pesticide Emergencies. Landscape Academy Course. Valley Community High School, Work-Study Program. Merced, CA. April 11, 2003.
- Weber, J. Pesticide Handler Safety (Spanish). Pesticide Applicator Recertification Course Puyallup, WA. April 18, 2003.
- O'Connor-Marer, P., J. Weber, and T. Stock.. Pesticide Handler and Fieldworker Instructor Training (English). Salinas, CA. May 1, 2003.
- Weber, J. Pesticide Safety Education Program State Report for California. Western Region Pesticide Meeting. Salt Lake City, Utah. May 6, 2003.
- Weber, J. Overview of Landscape Academy Course. Western Region Pesticide Meeting. Salt Lake City, Utah. May 6, 2003.
- Weber, J. Translating Pesticide Labels into Spanish. Western Region Pesticide Meeting. Salt Lake City, Utah. May 9, 2003.
- Weber, J. Farm Safety 4 Just Kids Booth – assisted with presentations and hands-on activities. Western States' Horse Show. Sacramento, CA. May 31, 2003.
- Weber, J., and T. Stock. Pesticide Handler and Fieldworker Instructor Training. (Spanish). San Luis Obispo, CA. June 4, 2003.
- Weber, J., and T. Stock. Pesticide Handler and Fieldworker Instructor Training (English). San Luis Obispo, CA. June 5, 2003.
- Weber, J., and T. Stock. Fieldworker Instructor Training. (English). San Luis Obispo, CA. June 6, 2003.
- Weber, J. Report on American Association of Pesticide Safety Educators' (AAPSE) Committee on Non-English Language Materials for Pesticide Safety Education. AAPSE Board of Directors' meeting. National Pesticide Applicator Certification and Safety Education Workshop. Honolulu, HI. August 10, 2003.
- Weber, J. Display of findings by the American Association of Pesticide Safety Educators' (AAPSE) Committee on Non-English Language Materials for Pesticide Safety Education. National Pesticide Applicator Certification and Safety Education Workshop. Honolulu, HI. August 12-14, 2003.
- *Weber, J. Using Surveys to Determine Language Needs. National Pesticide Applicator Certification and Safety Education Workshop. Honolulu, HI. August 12, 2003.*
- Weber, J. Preventing and Responding to Pesticide Emergencies. Pesticide Illnesses and Injuries: A Workshop for Tribal Health Care and Agricultural Professionals. Yuma, AZ. September 3, 2003.
- Weber, J. Preventing and Responding to Pesticide Emergencies. Pesticide Illnesses and Injuries: A Workshop for Tribal Health Care and Agricultural Professionals. Phoenix, AZ. September 4, 2003.
- Weber, J. Display of findings by the American Association of Pesticide Safety Educators' (AAPSE) Committee on Non-English Language Materials for Pesticide Safety Education. "Challenges in Agricultural Health and Safety" Conference. San Francisco, CA. September 7-10, 2003.
- Weber, J. How Languages and Culture Impact Worker Safety. Pesticide Regulatory Education Program. Davis, CA. September 14, 2003.

- Stock, T. and J. Weber. Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. Chico, CA. January 8, 2004.
- Weber, J. and T. Stock. Update on Pesticide Laws and Regulations. Landscape and Nursery Exposition. Sacramento, CA. January 14, 2004.
- Weber, J., and T. Stock. Hands-on Workshop, Instructor Training. Lodi, CA. January 21, 2004.
- Weber, J., and T. Stock Hands-on Workshop, Instructor Training. Napa, CA. March 2, 2004.
- Stock, T., and J. Weber. Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. San Luis Obispo, CA. March 17, 2004.
- O'Connor-Marer, P., J. Weber, and T. Stock. Pesticide Handler and Fieldworker Instructor Training. (English). Davis, CA. April 19, 2004.
- Weber, J., and T. Stock. Fieldworker Instructor Training. (English). San Luis Obispo, CA. April 20, 2004.
- Weber, J., and T. Stock. Pesticide Handler and Fieldworker Instructor Training (Spanish). Davis, CA. April 26, 2004.
- Stock, T. Preventing Pesticide Contamination of Water. Fresno, CA. June 11-2004.
- Weber, J. Language Needs of Pesticide Handlers. Pesticide Regulation Enforcement Program, Davis, CA. July 27-30, 2004.
- Stock, T. Pesticide Training for Strawberry Growers. Nipomo, CA. August 5, 2004.
- Weber, J. Pesticide Illness and Injuries Workshop. Oakland, CA. August 19, 2004.
- Weber, J. Pesticide Illness and Injuries Workshop. Pacific Grove, CA. August 31 and September 1, 2004

## 2. Publications

- O'Connor-Marer, PJ Licensing and Certification of Pesticide Applicators *IN* Pimentel, D editor, *Encyclopedia of Pest Management*, Marcel Dekker, Inc., NY, 2002
- Weber, J, D Clarke, G Perez, and PJ O'Connor-Marer. Pesticide Illnesses and Injuries: *A Manual for Tribal Community Health Care and Agricultural Professionals*, UC IPM, 2002
- Weber J, M Canevari, R Mullen and S Swift. Pesticide Safety for Small Farms. Video. Ilocano version. University of California, ANR Communication Services and University of Hawaii. 2003
- Weber, J. Pesticide Safety Curriculum for High School Landscape Academy Short Course. 2003

## 3. Education

- a) Training Seminar: Train the Trainer Workshop for Trainers of Pesticide Handlers and Agricultural Workers. June 12, 2002 in Winters, CA; July 18, 2002 in Winters, CA. February 13-14, 2003 in Escondido, CA; April 3-4, 2003 in Arlington, VA; April 30-May 1, 2003 in Salinas, CA.
- b) Short Course: Recognizing and Managing Pesticide Illness and Injuries for Tribal Community Health Care Professionals – May 29-31, 2002 in Yuma AZ and Phoenix, AZ; November 8, 2002, Porterville, CA.
- c) Conferences/Meetings Sponsored:
  - Western States Pesticide Meeting, San Diego, CA, May 14-17, 2002
  - Joint PNASH/WCAHS Conference, Coeur d'Alene, ID, September 16-18, 2002

- 15<sup>th</sup> Annual N AmerAgromedicine Consor Conf, San Diego CA, Nov 17-19, 2002
- PNASH/WCAHS Conference, San Francisco, CA, September 7-9, 2003
- Western States Pesticide Conference, Spokane, WA, May 10-12, 2004
- California Minor Crops Council Crop Tour, Ca, July 12-15, 2004
- PNASH/WCAHS Conference, Portland, OR, September 12-14, 2004

#### **G. STATES THE PROJECT WAS ACTIVE IN**

California, Nevada, Arizona, Hawaii, Washington

#### **COLLABORATION**

USDA CSREES, US EPA Office of Pesticide Programs  
California Department of Pesticide Regulation  
California Department of Health Services  
Cal-EPA Office of Environmental Health Hazard Assessment  
NIEHS Center for Environmental Health Sciences at UC Davis  
NIOSH Center for Occupational and Environmental Health at UC Berkeley  
Inter Tribal Council of Arizona  
California Department of Food and Agriculture  
Arizona Department of Agriculture, the University of Arizona  
University of Hawaii  
Pacific Northwest Agricultural Safety and Health Center  
North American Agromedicine Consortium  
American Association of Pesticide Safety Educators

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

Best Management Practices for Pesticide Use and Food Safety Among California's Small Farmers with Particular Reference to Limited English Speaking and Cultural Minority Farmers

#### **B. PROJECT OFFICER(s)**

Desmond A. Jolly, Ph.D., Principal Investigator  
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Aziz Baameur, M.S., Co-Investigator  
Calvin Fouche, Co-Investigator  
Manuel Jimenez, Co-Investigator  
Richard Molinar, M.S., Co-Investigator

#### **C. PROJECT DESCRIPTION**

This project involves targeted outreach to farm households in limited English speaking agricultural communities and the development and implementation of pesticide safety education and training programs.

There are two main objectives: (1) Identify and document pesticide use and application practices among limited English-speaking growers; and (2) Improve pesticide use and application practices to minimize exposure risks, enhance farm household safety, and reduce environmental degradation.

#### **D. PROJECT START AND END DATES**

October 1, 1999 - Ongoing

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Small Farm Program Advisors and Program Representatives conducted 24 training seminars and numerous on-farm and in-office individualized consultations and training sessions regarding pesticide safety and food safety. The Small Farm Center and advisors continue to disseminate information developed in prior years of the project, including pesticide safety information in Spanish, Hmong, Korean, and Tongan. Pesticide safety and food safety information is available and accessible on the popular Small Farm Center website (<http://www.sfc.ucdavis.edu>), with new publications added regularly.

Fresno Program Representative Michael Yang conducts a bi-monthly Hmong-



language radio outreach broadcast. Broadcast content includes: pesticide safety, integrated pest management, organic production, and other alternatives to pesticide use. These radio broadcasts are a proven effective means to reach Hmong farmers and other agricultural communities within the San Joaquin Valley.

## F. PROJECT PRODUCTS

### 2. Publications

#### d. Other Publications:

Glossary of most commonly used words and phrases in English and Hmong is available at the Fresno Cooperative Extension website (<http://cefresno.ucdavis.edu>) or Small Farm Center website (<http://www.sfc.ucdavis.edu>)

### 3. Education / Training / Outreach

#### a. Training Seminars:

Date	Event/Activity	Location	Facilitator
04/09/03	Pesticide Training (insecticide, fungicide, herbicide, etc.)	Fresno	M. Yang
05/14/03	Pesticide Training (personal protective equipment)	Fresno	M. Yang
06/03/03	Pesticide and Weed Identification (field training for Lao farmers)	Fresno	M. Yang
07/10/03	Pesticide Training (pesticide use reporting and labeling)	Fresno	M. Yang
08/14/03	<b>Niche crop Field Day:</b> Training on reflective mulching and cost effective pest management practices for niche crop production	UC Kearney	M. Jimenez
08/28/04	Pesticide Training (inspection and container use/rinse)	Fresno	Michael Yang
11/21/03	Organic Strawberry Production (pest management)	Hollister	A. Baameur
11/22/03	Conventional Strawberry Production (pest management)	Morgan Hill	A. Baameur
11/24/03	Organic Strawberry Production (pest management)	Salinas	A. Baameur
02/17/04	Pesticide Safety Training	Fresno	M. Yang
02/19/04	Pesticide Safety Training	Fresno	M. Yang
02/24/04	Pesticide Safety Training	Fresno	M. Yang
02/26/04	Pesticide Safety Training	Fresno	M. Yang
03/02/04	Pesticide Safety Training	Fresno	M. Yang
03/04/04	Pesticide Safety Training	Fresno	M. Yang
03/25/04	Pesticide Safety Training for Ethnic Chinese Growers	San Martin	A. Baameur
04/14/04	Pesticide Regulations and Personal Protective Equipment	Fresno	M. Yang
04/25/04	Weed Management (organic) Field Day	Lodi	B. Fouche
05/05/04	Fusarium Control with Biofumigation	Hollister	A. Baameur
05/12/04	Pesticide Monthly Use Reports	Fresno	M. Yang
06/08/04	Fusarium Control with Biofumigation	Hollister	A. Baameur
07/14/04	Integrated Pest Management Training	Fresno	M. Yang
07/28/04	Management Options for the <i>Diaprepes</i> Root Weevil	Gilroy	A. Baameur

09/15/04	Weed Identification and Control	Fresno	M. Yang
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**c. Hazard Surveys / Consultations:**

Small Farm Advisors in the Central Valley (San Joaquin, Fresno, and Tulare Counties) provided consultation and individualized hands-on training to over 400 producers over the course of the year. In San Joaquin County, Small Farm Advisor Calvin Fouche estimates that 80% of consultation and training concerned pesticide safety, and 20% concerned food safety.

In Fresno County, Small Farm Advisor Richard Molinar and Program Representative Michael Yang provided consultations during farm visits and walk-in office visits, and technical assistance with permits and chemical use reports as well as pesticide safety assistance.

**d. News Letters:**

Fresno: Spring and Fall, 2004 newsletters in English and Hmong, produced in conjunction with the U.S. EPA, addressed reduced risk pesticides.

**f. Other:**

Throughout the year, Michael Yang of Fresno has hosted a bi-monthly radio talk show focusing on pesticide safety and broadcast in Hmong.

**4. Conferences / Meetings Sponsored:**

Conferencia Para Agricultores, Nov 20, 2003, UC Kearney, R. Molinar  
 Small Farm Specialty Crop conference, May 25-27, 2004 in Escondido, included sessions on reduced risk pest management.

**G. STATES THE PROJECT WAS ACTIVE IN**

Project activities have been primarily based in California; however, the impacts of our research, knowledge, outreach, and materials development are felt well beyond California's borders.

**VI. COLLABORATION**

The UC Small Farm Center and Small Farm Program advisors collaborated with a number of organizations and sponsoring agencies in the provision of training and dissemination of information. Collaborators include the U.S. Environmental Protection Agency, Santa Clara Valley Water District, California Department of Food and Agriculture, USDA Risk Management Agency and others.

### **III. CENTER PROJECT REPORT BY CORE / TYPE:**

#### **A. PROJECT TITLE**

Musculoskeletal Disorders in Hand Harvest of Vegetable Crops

#### **B. PROJECT OFFICER(s)**

John A. Miles, Principal Investigator  
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#### **C. PROJECT DESCRIPTION**

The agricultural ergonomics project seeks to evaluate ergonomic risk factors in at least one vegetable crop and one tree-fruit crop each year and to develop a list of possible interventions for each high-risk job situation.

#### **D. PROJECT START AND END DATES**

October 2001 through September 2004

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Stoop labor was found to be a common component of the work required in many vegetable crops. Hired workers in agriculture bear the brunt of injuries (73% as compared to family workers at 27%), and 67% of those injuries occur to Hispanic workers. Of all occupational illnesses or injuries for farm workers, musculoskeletal disorders (MSD) are the most common. Among farm workers, back strain accounts for 39% of all strains and sprains. NIOSH designates this group of workers as a Special Population at Risk. California alone employs nearly 1 million hired farm workers per year, accounting for an estimated 25% of production costs.

The heavy physical work, frequent bending and twisting, and awkward postures associated with agricultural jobs place farm workers at high injury risk. Meyers cites three general risk factors as both endemic and of highest priority throughout the agricultural industry. They are: sustained or repeated full body bending (stoop); lifting and carrying heavy loads (over 50 lb.); and very highly repetitive hand work (clipping, cutting).

The lack of feasible alternatives for these workers caused us to progress in two directions. The first was to begin development of labor aides to reduce the risk associated with the stooped work posture. This work has not been completed, but at this time we are evaluating the use of powered carts which can carry workers in a semi-prone position while they do tasks very near the level of the ground. It is clear that this approach will be very crop and task specific. For some tasks in some crops this may be a viable solution. For many other

situations it is not feasible to carry workers in a semi-prone position. A key example of when it is not likely to be appropriate is for the hand weeding of crops, where the workers may have to apply substantial force in order to pull the weeds.

The second direction taken was to jointly sponsor an International Symposium on Stoop Postures with NIOSH. This conference was Held on July 29-30 in the Elihu Harris State Office Building in Oakland. This was attended by about 100 people from across the United States, Northern Europe, and India. The conference description follows:

“There is strong evidence associating stooped (and squatting) postures in the workplace with high risk of low back and lower extremity disorders. While some may think such postures uncommon in the modern workplace, they remain widespread in construction, agriculture, mining and other industries. For the most part, few low-cost practical interventions exist for jobs requiring stooped (or squatting) postures. Worse, there is no organized national research program aimed at inventorying and assess either individual interventions or overall strategies to prevent or mitigate the effects of prolonged stooped postures”

## **F. PROJECT PRODUCTS**

### **1. Presentations**

- Miles, John A., “Feasibility of Interventions in Agriculture.” 2004 National Symposium on Agricultural Health and Safety; Keystone, Colorado, June 20-24, 2004.
- Miles, John A., “Agricultural Interventions in the United States.” Stoop Postures in the Workplace; Oakland, California, July 29-30, 2004.

### **2. Publications**

#### **Trade Journals:**

Miles, John, “Back Injury Intervention.” Resource, September 2004, p11-12.

### **3. Conferences / Meetings Sponsored**

Stoop Postures in the Workplace, July 29-30, 2004; Oakland California

## **G. STATES THE PROJECT WAS ACTIVE IN California**

## **III. PROGRESS REPORT ON FEASIBILITY PROJECTS**

Work has been initiated on both powered and unpowered devices to support a portion of the worker’s body weight while they accomplish tasks near ground level. To date we have not been able to accommodate the worker acceptability requirements. Since much of the stoop work is also paid on an incentive basis, any device which is perceived to reduce productivity is immediately rejected. It will take many iterations to produce the type of device which is likely to be acceptable to the workers. Neither the time nor the budget of this project was sufficient to provide the needed design and development activity.

## **VI. COLLABORATION**

Our collaborators were the growers who gave access to their workers. This included

strawberry growers and orchard tree nurseries. Confidentiality agreements with these collaborators preclude their specific identification.

### **III. CENTER PROJECT / ACTIVITIES SECTION:**

#### **A. PROJECT TITLE**

Evaluation of the NAGCAT Tractor Guidelines

#### **B. PROJECT OFFICER(s)**

Fadi A. Fathallah  
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#### **C. PROJECT DESCRIPTION**

The objective of this study is to systematically assess the most common tractors operated by children with respect to dimensional and operational characteristics in order to identify any potential strength and anthropometric mismatches between the physical characteristics of children and adolescents of ages 12 to 16 years (ages recommended for tractor operation by North American Guidelines for Children's Agricultural Tasks, NAGCAT) and the tractors they are operating. The results of this study will provide scientific evidence of the extent to which the NAGCAT tractor guidelines (developed by consensus) actually reflect a match between the physical abilities of children and adolescents 12 to 16 years and the tractors they commonly operate. It is anticipated that once the recommended revisions are incorporated into the NAGCAT, the risks of traumatic and fatal injuries to children due to tractor operation will be reduced

#### **D. PROJECT START AND END DATES**

August 1, 2003 - July 31, 2006

#### **E. PROJECT ACTIVITIES / ACCOMPLISHMENTS**

Hired undergraduate students to assist in data collection  
The project investigators had several conference call meetings  
Conducted several pilot testing  
Developed a new approach for capturing three-dimensional description of tractors using PhotoModeler software  
Finalized data collection instrument  
Identified most used tractors in the US through data obtained from NIOSH researchers  
Contacted tractor dealerships and farmers for access.  
Started the data collection phase- Collected data on 17 tractors

#### **F. PROJECT PRODUCTS**

**1. Presentations:** Poster presentation at the Agricultural Health and Safety Centers NIOSH/Directors Meeting, May 13, 2004, Davis, CA

**G. STATES THE PROJECT WAS ACTIVE IN  
California**

4.

**VI. COLLABORATION**

1. Barbara L. Marlenga, PhD:

Research Scientist, Marshfield Medical Research and Education Foundation, a Division of Marshfield Clinic, Marshfield, WI. NIOSH National Children's Center for Rural and Agricultural Health and Safety.

2. William Pickett, PhD:

Associate Professor, Department of Community Health and Epidemiology, Queen's University, Kingston, Canada.

3. James Meyers, Ed. D.:

Agricultural & Environmental Health Specialist, NIOSH Center for Occupational and Environmental Health, School of Public Health, Univ. of Calif., Berkeley

4. John A. Miles, PhD:

Professor, Department of Biological and Agricultural Engineering, UC Davis

#### **IV. PROGRESS REPORT ON FEASIBILITY PROJECTS**

Please refer to individual project reports for Drs. Marc Schenker and John Miles.

#### **V. REPORT ON SPECIFIC IMPROVEMENTS IN AGRICULTURAL SAFETY AND HEALTH THAT RESULTED FROM CENTER ACTIVITIES (RESEARCH TO PRACTICE).**

Please refer to individual project report for Dr. Barry Wilson

#### **VI. COLLABORATION**

Much active collaboration existed, as detailed in the individual project reports. Other NIOSH Agricultural Health Centers with whom collaborations and interactions existed include the Iowa, Wisconsin, Kentucky, North Carolina, Colorado, Washington, Texas, Ohio and New York Centers. Active collaboration existed with NIOSH, particularly with collaborators in the Division of Respiratory Diseases in Morgantown. Other Federal agencies with which collaborations or interactions existed include the DHHS, EPA, NIEHS and NIH. The Center maintains active collaborations with various state agencies including Cal-EPA, Department of Industrial Relations, Department of Food and Agriculture, Department of Health Services, and the Department of Pesticide Regulation. The Center collaborated with investigators at the PNASH Center to co-host a joint conference held in Troutdale, OR on September 12-14, 2004. The theme of this conference was “Cultivating a Sustainable Agricultural Workplace”.



## APPENDIX

### I. TOTAL CENTER BUDGET FOR FY 2004

- |  |   |
|--|---|
| 1. Total NIOSH Expenditures :                | \$1,023,024   |
| 2. In-Kind Contributions:                    | \$ 134,273  |
| 3. Other Outside Funding Received by Center: | Project funded at level<br>proposed in Center's application |

### II. CENTER PROJECTS / ACTIVITIES FOR FY 2004

1. Ongoing Projects: 7
2. Projects Completed:
  - a. "Extending Pesticide-Related Health and Safety Programs to Underserved Agricultural Populations in the Western US"
  - b. "Prevention of Musculoskeletal Disorders in Hand Harvest of Vegetable Crops"
3. New Projects:  
"Agricultural and Environmental Health for Latino and Indigenous Farmworkers"

### III. CENTER INVESTIGATORS

1. Scientific Investigators: 10
2. Program Support Staff: 2

### IV. CENTER PRODUCTS

1. Presentations: 31 from Section III projects
2. Publications
  - a. Peer Review Journal: 24 from Section III
  - b. Trade Journals: 1 from Section III
  - c. Fact Sheets/Brochures/Tech Publications: 1 general plus 2 from Section III
  - d. Other Publications: 4 general plus 9 from Section III
3. Education/Training/Outreach
  - a. Training Seminars: 5 general plus 32 from Section III
  - c. Hazard Survey/Consultation: 3 from Section III
  - d. Newsletters: 4 general issues plus 6 issues from Section III
  - g. Other (radio broadcasts): 24 from Section III
4. Conferences / Meetings Sponsored: 32 from Section III projects plus
  - 1) Monthly Brown-Bag Seminars. UC Davis, CA. October 2003-June 2004.
  - 2) Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. Chico, CA. January 8, 2004.
  - 3) Update on Pesticide Laws and Regulations. Landscape and Nursery Exposition. Sacramento, CA. January 14, 2004.
  - 4) Hands-on Workshop, Instructor Training. Lodi, CA. January 21, 2004.
  - 5) Stock Hands-on Workshop, Instructor Training. Napa, CA. March 2, 2004.
  - 6) Avoiding Water Contamination and Pesticide Drift, Instructors' Training Course. San

- Luis Obispo, CA. March 17, 2004.
- 7) Pesticide Handler and Fieldworker Instructor Training. (English). Davis, CA. April 19, 2004.
  - 8) Fieldworker Instructor Training. (English). San Luis Obispo, CA. April 20, 2004.
  - 9) Pesticide Handler and Fieldworker Instructor Training (Spanish). Davis, CA. April 26, 2004.
  - 10) NIOSH-Ag Center Director's Meeting. UC Davis, CA. May 13-14, 2004.
  - 11) Preventing Pesticide Contamination of Water. Fresno, CA. June 11-2004.
  - 12) Language Needs of Pesticide Handlers. Pesticide Regulation Enforcement Program, Davis, CA. July 27-30, 2004.
  - 13) Pesticide Illnesses and Injuries: A Workshop for Health Care Providers and Agricultural Professionals. Oakland, CA. August 18-19, 2004.
  - 14) Early Determinants of Adult Health: 6<sup>th</sup> Annual UC Davis Conference for Environmental Health Scientists. Napa, CA. August 30, 2004.
  - 15) Pesticide Illnesses and Injuries: A Workshop for Health Care Providers and Agricultural Professionals. Asilomar, CA. August 31-September 1, 2004.
  - 16) Cultivating a Sustainable Agricultural Workplace. Troutdale, OR. September 12-14, 2004.

**V. ADMINISTRATIVE REPORT**

Dr. Patrick O'Connor-Marer retired on September 30, 2004. Dr. Kent Pinkerton has accepted the deputy director position for the Center.

Dr. Ketty Mobed came on board in November 2003 to serve as the new Center manager.